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Energy performance requirements for new buildings in 11 countries from Central Europe

Exemplary comparison of three buildings

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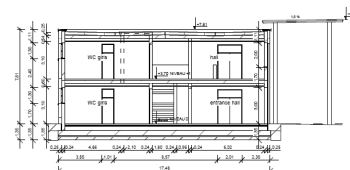
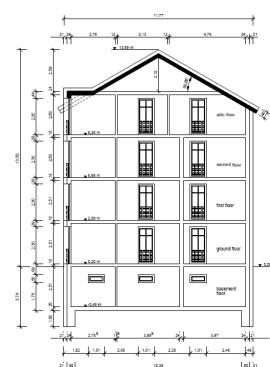
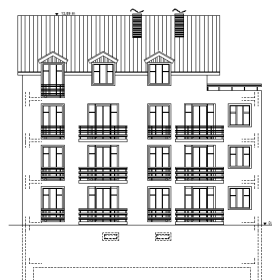
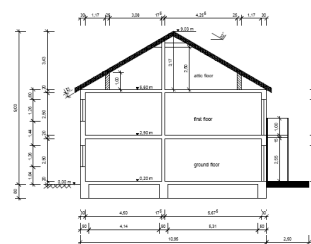
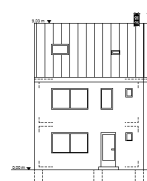
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Energy performance requirements for new buildings in 11 countries from Central Europe – Exemplary Comparison of three buildings

performed on behalf of the
**German Federal Office
for Building and Regional Planning**
(Bundesamt für Bauwesen
und Raumordnung, Bonn)

Darmstadt/Germany,
5th December 2008



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performed on behalf of the German Federal Office for Building and Regional Planning
(Bundesamt für Bauwesen und Raumordnung, Bonn) /

German project title: „Energiesparrecht im mitteleuropäischen Vergleich – energetische Anforderungen an Neubauten“ (Vertrag Z 6 – 10.08.17.7-07.16)

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1 Summary

The objective of the present comparison study is to show which energy efficiency requirements have to be complied in different European countries when a new building is going to be constructed. For this purpose three Model Buildings were defined: a single-family house, a multi-family house and a school building. For each involved country (or region) the energy quality of the thermal envelope was determined which is necessary in order to just comply with the building code. Due to requirements on the overall energy performance the requested envelope quality usually depends also on the type of heat supply system or energy carrier. Therefore the systems were varied in a parameter study. The main result for each of the three Model Buildings is a comparison table which shows the heat transfer coefficient by transmission (a sort of mean U-value) for the different countries differentiated by supply system types. In a final step the primary energy demand according to the German regulation (EnEV 2007) was calculated for every envelope/system combination of the different countries. This allows a comparison of buildings with different supply systems. The study was performed by experts from 11 European member states: Germany, Austria, Czech Republic, Poland, Sweden, Denmark, UK, The Netherlands, Belgium, Luxembourg and France.

2 About the project

In Germany the transposition of the Energy Performance of Buildings Directive (EPBD) was performed by an amendment of the German Energy Saving Ordinance (Energieeinsparverordnung EnEV) in the year 2007. During this process formal and methodological changes were applied whereas the requirements remained the same. In year 2007 the German government announced to undertake a new revision which mainly will introduce a higher energy performance mandatory for new and refurbished buildings. In the discussion about tightening the requirements in Germany the question often arises which energy efficiency standards are applied in other European countries with comparable climatic conditions. The present study aims at giving some more transparency in this field.

The concrete objective of the project is to compare the energy performance requirements for new buildings in Germany with those of several other European countries with similar climate conditions. Due to the very different methods and traditions it is clear that an exact comparison between the countries will not be possible. Therefore this study is based on example buildings and certain assumptions that have been chosen by IWU and which certainly reflect a specific (German) perspective. Certainly it would be possible to select other methodical approaches and maybe the results could be (slightly) different.

The question to be answered by each partner is: Which U-values have to be chosen for roof, walls, windows and floor if a given building is supposed to just comply with the requirements for new buildings in the respective country. Since generally the level of insulation indirectly depends on the building geometry and of the supply system type these parameters are varied. In the framework of the project three example buildings are analysed: a single family house (which is the subject of this report), a multi family house and a school building. Furthermore the installation of several different supply systems is assumed.

The analysis focuses on the comparison of the tangible quality of the building envelope defined by the national regulations. Neither the different certification methodologies nor the aspects of practical implementation of these standards are a topic of the study.

The analysis is performed on behalf of the German Federal Office for Building and Regional Planning (BBR) by IWU (Institut Wohnen und Umwelt / Institute for Housing and environment) with the assistance of the following partners:

Tab. 1: Project partners

N°		Country	Institution
1	de	Germany	IWU (Institute for Housing and Environment)
2	at	Austria	e7 - Energie-Markt-Analyse
3	cz	Czech Republic	Stu-k
4	pl	Poland	NAPE (National Energy Conservation Agency S.A.)
5	se	Sweden	Mälardalen Universit�t, V�ster�s/Eskilstuna
6	dk	Denmark	SBI (Danish Building Research Institute)
7	uk	UK	BRE (Building Research Establishment)
8	nl	The Netherlands	BuildDesk (former EBM-Consult)
9	be	Belgium (Flanders)	BBRI (Belgian Building Research Institute)
10	lu	Luxembourg	Goblet Lavandier & Associ�s S.A.
11	fr	France	ADEME - Agence de l'Environnement et de la Ma�trise de

3 Methodical approach

3.1 Proceeding

The analysis consisted of the following steps:

Step 1: Definition of the thermal envelope of the building (IWU)

The following documents were elaborated by IWU and distributed to the partners:

- a set of plans (scale 1:100, see Appendix),
- a table with the envelope element areas, determined according to the German regulations (basis: external dimensions, see chapter 4.1, 5.1 and 6.1 for the three buildings)
- an Excel sheet with the detailed envelope area calculation, which was the basis of the above mentioned table (see Appendix)

Step 2: Definition of the supply system variants (IWU)

IWU defined a set of supply systems for each Model Building (see chapter 4.2, 5.2 and 6.2). The partners received a table defining the different variants on two levels (see Appendix):

- a determination of the type of the components, which was often sufficient for the calculation;
- detailed information about the components (for example thermal power of the heat generator, electric power of pumps, length and heat loss of heating pipes), which were to be used only in case that national standard values are not available.

Step 3: Determination of the U-values (all partners)

Each partner was requested to determine the U-values which have to be chosen for this building in order to comply with the building code – under assumption of the different supply system variants.

The principles of this procedure were:

- In those countries in which the thermal envelope is not defined by the external dimensions the envelope area table delivered by IWU could not be used. The concerned partners were supposed to determine the envelope areas on their own by use of the building plans.
- For simplification purpose it was assumed that the thicknesses of the building envelope elements do not depend on the U-value (the U-value variation can therefore be seen as a variation of the thermal conductivity).
- The U-value for each construction element was supposed to be the “pure” thermal transmittance not including supplements or reductions caused by transmission losses at the border of the elements. (In case of the opaque elements the study may be seen as a comparison of insulation thicknesses.)
- If there are different methods in a country the most common should be used (typically the most simple method).
- If for a country the requirements are different for certain regions a region had to be selected where the climate conditions are as close as possible to the German ones.
- If deviations from the building or system definitions were necessary these had to be documented.

The results of this analysis was documented by each partner in a uniform sheet (see Appendix: “Country Sheets”)

Step 4: Calculation of a simplified heat transfer coefficient by transmission and cross-country comparison (IWU)

For purpose of comparison a weighted average of the U-values of the different construction elements were calculated by IWU. For this weighting the external area was used. The result is a sort of simplified heat transfer coefficient by transmission.¹ The calculation of these values can be found in the country sheets (Appendix), the results of the cross-country comparison are shown in chapter 4.3, 5.3 and 6.3.

Step 5: Calculation of the primary energy demand according to the German official method and cross-country comparison (IWU)

In order to compare the total energy performance of the building variants from the different countries the primary energy demand was calculated according to the rules of the German regulations (Energy Saving Ordinance / Energieeinsparverordnung EnEV 2007). The resulting values are shown in the chapters 4.4, 5 and 6.4.

3.2 Limits of evidence

The chosen method is capable to depict the level of national energy efficiency requirements in a concrete and exemplary way. Of course, the exactness and evidence of this comparison is limited since the results depend on factors which were not considered in this study:

- Number of Model Buildings: The example buildings considered in this study represent only a small fraction of possible building geometries. The dependence of the requirements from the surface to volume relation and from the building size is different for each country. In consequence the relation of the requirements between the different countries could possibly change if different buildings were considered.
- Definition of the thermal envelope: The definition of the thermal envelope in a unique way is not always possible, since the rules sometimes allow different solutions (cellar rooms, stair wells, garages, winter gardens, ...). In order to avoid such uncertainties rather simple building geometries were selected for this investigation (which may have effects on the requirement level, see above). A special problem is the energy balance calculation for an apartment building. In some countries the thermal envelope is considered to be the surface of the whole building, in others only the thermal envelope of the apartments are considered, in some countries there is

¹ In case of a well designed building with minimized constructive thermal bridges this simplified heat transfer coefficient by transmission is very close to the real value including thermal bridging (to the experience of the authors). A precondition is that the envelope area determination is based on external dimensions.

a mix of both approaches. In order to compare the U-values one of these approach has to be chosen. (In the present study the surface of the whole building was used.)

- Variety of methods in some countries: In some countries different proofs of conformity are permitted. Applying different methods will typically produce different results for the same building. (The rule for the present study was to use the most common method, which is typically one with a lesser effort.)
- Frequentness of supply system types in each country: The comparison of the results for the primary energy (calculated according the German EnEV) shows that the maximum allowable demand of non-renewable energy can be very different, depending on the system or energy carrier. For a comprehensive comparison of the countries information about the frequentness of the installed supply system types is necessary.
- Implementation in practice: The practical realisation of equally designed buildings may be different from country to country. On the one hand the implementation of the building code certainly depends on the control mechanisms applied by state. It may also depend on traditions of planning and quality assurance.

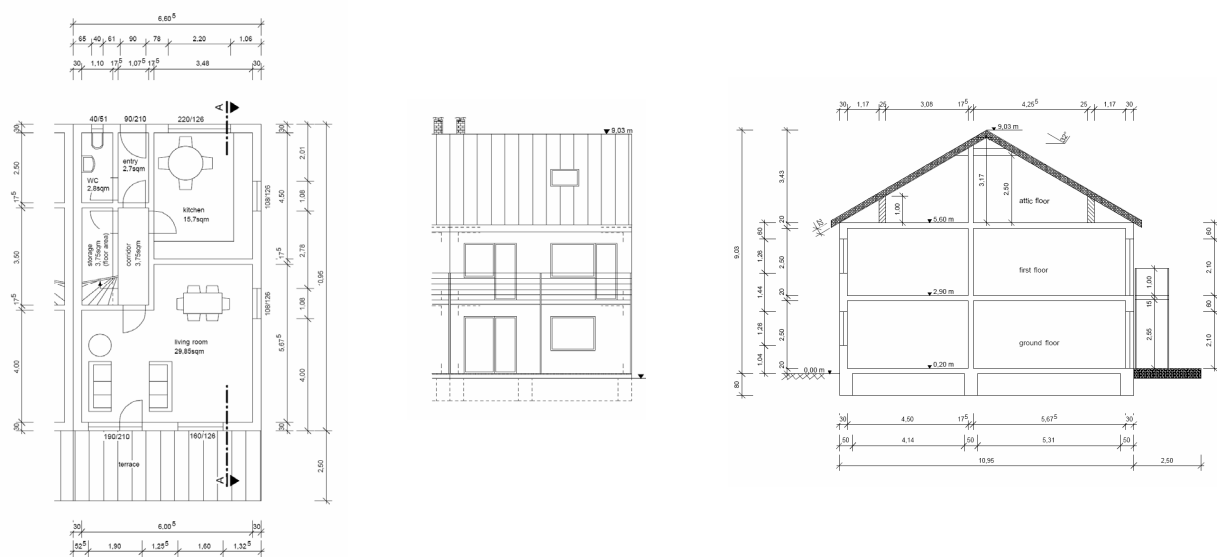
4 Model Building 1: semi-detached single family house

4.1 Thermal envelope

Model Building 1 is a semi-detached single family house with 140 m² living area. A building with a simple geometry has been chosen in order to keep the envelope area evaluation transparent. Two storeys and the attic is located inside the thermal envelope.

Fig. 1 displays the geometry, Tab. 2 the thermal envelope areas. A complete set (floor plans of all storeys, vertical section, façade plans) and a table specifying the envelope area calculation can be found in the Appendix.

Fig. 1: Model Building 1 – semi-detached single family house:
Overview of the building (the complete set of plans can be found in the Appendix)²



² Source for the plans of this building: Kadir Durmaz: Modellrechnungen zur kommenden Energieeinsparverordnung. Vertiefearbeit an der TU Darmstadt. Supervisors: Susanne Schwickert (TUD) / Tobias Loga (IWU); TU Darmstadt August 2000 revised by Christina Kappich A-HP/Energie&Haus on behalf of IWU

Tab. 2: General building data / thermal envelope areas

Model building N° 1			
Single family house (semi-detached / end-terrace)			
General building data			
gross floor area of all storeys	ext. dim.	(inside therm. env.)	217,0 m ²
useful floor area	int. dim.	(inside therm. env.)	151,3 m ²
living area	int. dim.	(inside therm. env.)	140,2 m ²
building volume	ext. dim.	(inside therm. env.)	538,5 m ³
relation envelope surface area to building volume			0,588 m ² /m ³
Envelope surface area (ext. dim.)			
roof			82,5 m ²
walls			133,4 m ²
floor above soil			72,3 m ²
door			1,9 m ²
windows	North	vertical	6,8 m ²
	North	skylight	1,5 m ²
	East	vertical	4,1 m ²
	South	vertical	12,8 m ²
	South	skylight	1,3 m ²
sum envelope surface area			316,6 m ²
ext. dim. = external dimensions			
int. dim. = internal dimensions			

4.2 Types of supply systems

Reference case: variant “basis”

As a base case for the parameter variation a system with the following components has been defined:

- low temperature boiler (non-condensing) for heating and domestic hot water (dhw), installed in the central heating room (attic)
- hot water storage, installed in the central heating room (attic)
- distribution system for space heating completely inside of the thermal envelope
- distribution system for DHW completely inside the thermal envelope, no circulation ducts
- no ventilation system

The details of the system can be found in the Appendix.

Variation of parameters

Starting from the base case a variation of heat generators (hg-*), of the domestic hot water system (dhw-*) and of the ventilation system (vent-*) was performed. Furthermore two variants were considered where more than one component was changed (sys-*). The complete definition of these systems is documented in the Appendix.

Tab. 3: Definition of the supply system variants

Label	Type	Varied component
basis	basis variant	low temperature boiler for heating and dhw, no vent. system
hg-cond	variation heat generator	condensing boiler
hg-pellet	variation heat generator	wood pellet boiler
hg-hp	variation heat generator	electric heat pump
dhw-el	variation hot water system	decentral electric
dhw-sol	variation hot water system	thermal solar system
sys-el	variation heating & hot water system	electric resistance system
vent-exh	variation ventilation	exhaust ventilation system
vent-rec	variation ventilation	ventilation system with heat recovery
sys-cond/sol/rec	variation heating, hot water and ventilation system	condensing boiler + solar dhw system + ventilation system with heat recovery

4.3 Results for the thermal quality of the envelope

Compliance with national requirements for new buildings – maximum respectively adapted U-values

For the above described building the level of thermal insulation was identified which is determined by the building regulations of each participating country. As a result each partner provided a table with U-values of floor, roof, walls and windows which have to be selected for this building in order to comply with the national / regional requirements. If the thermal insulation requirements depend on the supply system efficiency the U-values were determined for different system types.

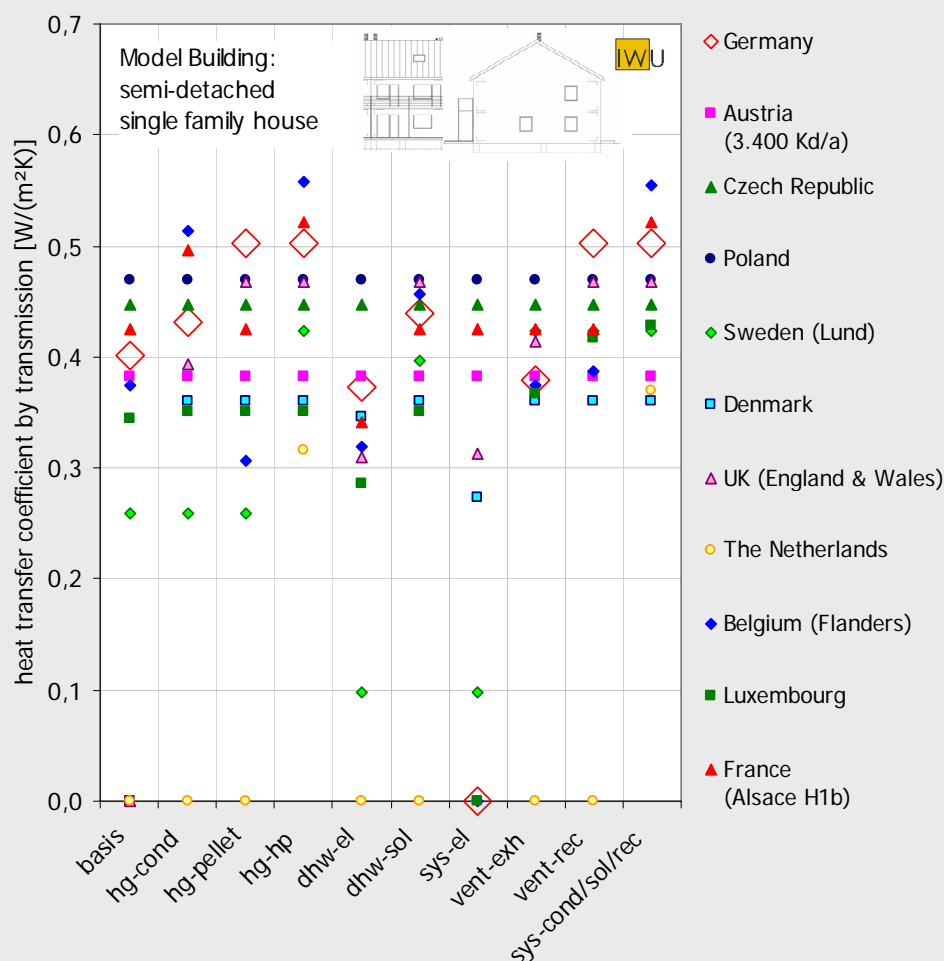
The U-values determined by each partner can be found in the Appendix (“Country Sheets”).

Simplified heat transfer coefficient by transmission

For each of the variants the U-values of the different construction elements were weighted by their areas (external dimensions, considering reduction factors for losses to soil, if applicable). The result is a simplified heat transfer coefficient (without losses caused by thermal bridging), which is sort of a mean U-value of undisturbed elements. The resulting values for the different countries are displayed in Tab. 4 and Fig. 2.

After collecting the results from the partners it turned out that the pre-defined basis variant could not be realised in 5 countries, partly because non-condensing gas boilers are not allowed any more for new buildings (Denmark, UK), partly because the installation of ventilation systems is obligatory (Sweden, Belgium) and in one case because the overall requirements are so severe (the Netherlands). Also some of the other variants were changed by the respective partners (see foot-notes at the table) in order to achieve a compliance. In these cases the heat transfer coefficient can not directly be compared with the others. In consequence the definition of the variants was changed when the second building was analysed (see chapter 5.3)

Fig. 2: Results for Model Building 1 (semi-detached single-family house) – simplified heat transfer coefficient by transmission
(zero = requirements can not be complied, “-“ in Tab. 4)



Tab. 4: Results for Model Building 1 (semi-detached single-family house) – simplified heat transfer coefficient by transmission

variant name	basis	hg-cond	hg-pellet	hg-hp	dhw-el	dhw-sol	sys-el	vent-exh	vent-rec	sys-cond/sol/rec
variant type	basis	variation heat generator	variation heat generator	variation heat generator	variation hot water system	variation hot water system	variation heating & hot water system	variation ventilation	variation ventilation	variation heating, hot water and ventilation system
short description	low temperature boiler for heating and dhw, no vent. system	condensing boiler	wood pellet boiler	electric heat pump	decentral electric	thermal solar system	electric resistance system	exhaust ventilation system	ventilation system with heat recovery	condensing boiler + solar dhw system + ventilation system with heat recovery
Heat transfer coefficient by transmission* [W/(m²K)]										
Germany	0,40	0,43	0,50	0,50	0,37	0,44	-	0,38	0,50	0,50
Austria (3.400 Kd/a)	0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38
Czech Republic	0,45	0,45	0,45	0,45	0,45	0,45	0,45	0,45	0,45	0,45
Poland	0,47	0,47	0,47	0,47	0,47	0,47	0,47	0,47	0,47	0,47
Sweden (Lund)	0,26 ²⁾	0,26	0,26	0,42 ²⁾	0,10	0,40 ²⁾	0,10 ²⁾	0,42 ³⁾	0,42	0,42
Denmark	-	0,36	0,36	0,36	0,35 ¹⁾	0,36 ¹⁾	0,27	0,36 ¹⁾	0,36 ¹⁾	0,36
UK (England & Wales)	-	0,39	0,47	0,47	0,31 ¹⁾	0,47 ¹⁾	0,31	0,41 ¹⁾	0,47 ¹⁾	0,47
The Netherlands	-	-	-	0,32	-	-	-	-	-	0,37
Belgium (Flanders)	0,37 ²⁾	0,51 ²⁾	0,31 ²⁾	0,56 ²⁾	0,32 ²⁾	0,46 ²⁾	-	0,37	0,39	0,55
Luxembourg	0,34	0,35	0,35	0,35	0,29	0,35	-	0,37	0,42	0,43
France (Alsace H1b)	0,43	0,50	0,43	0,52	0,34	0,43	0,43	0,43	0,43	0,52
relation to variant "basis" of Germany										
Germany	100%	108%	125%	125%	93%	110%	-	95%	125%	125%
Austria (3.400 Kd/a)	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%
Czech Republic	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%
Poland	117%	117%	117%	117%	117%	117%	117%	117%	117%	117%
Sweden (Lund)	65% ²⁾	65%	65%	106% ²⁾	24%	99% ²⁾	24% ²⁾	106% ³⁾	106%	106%
Denmark	-	90%	90%	90%	86% ¹⁾	90% ¹⁾	68%	90% ¹⁾	90% ¹⁾	90%
UK (England & Wales)	-	98%	116%	116%	77% ¹⁾	116% ¹⁾	78%	103% ¹⁾	116% ¹⁾	116%
The Netherlands	-	-	-	79%	-	-	-	-	-	92%
Belgium (Flanders)	93% ²⁾	128% ²⁾	76% ²⁾	139% ²⁾	80% ²⁾	114% ²⁾	-	93%	97%	138%
Luxembourg	86%	87%	87%	87%	71%	87%	-	92%	104%	107%
France (Alsace H1b)	106%	124%	106%	130%	85%	106%	106%	106%	106%	130%

Remarks

*) considering transmission losses through thermal envelope areas determined by external dimensions, not explicitly considering possibly supplements or reductions by thermal bridging

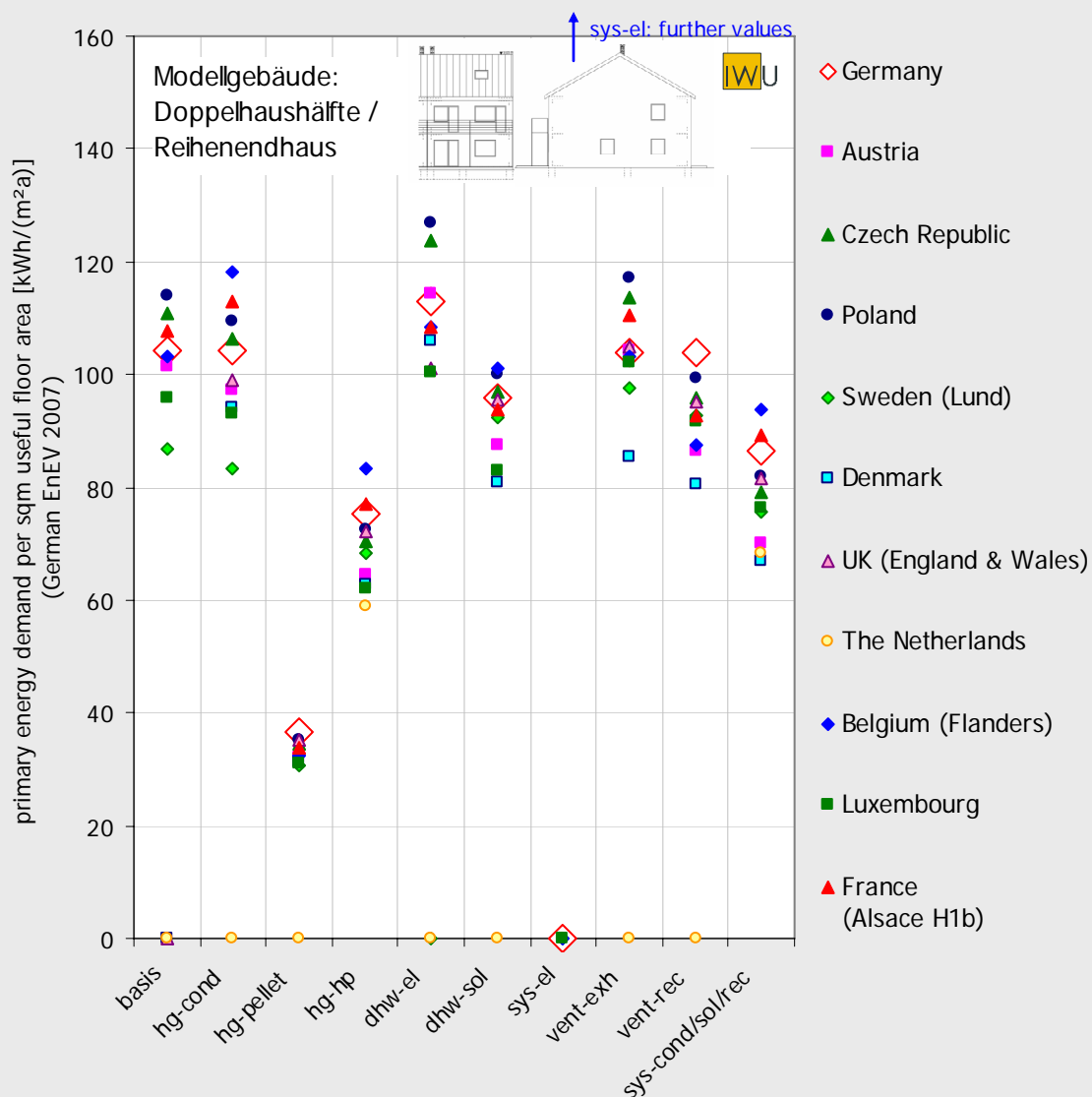
Deviations from the variant definition

- 1) condensing boiler (mandatory) in place of low temperature boiler
 2) with exhaust ventilation system (mandatory)
 3) with an additional dhw heatpump

4.4 Primary energy demand (according to German regulations)

Based on the U-values and the type of supply system the primary energy demand was calculated according to the German Energy Saving Ordinance (EnEV 2007) for each variant from each country. The simplified procedure based on seasonal energy balance for the building and table values for the system calculation was applied.³ Supply system variants which differ from the prescribed definitions were calculated accordingly, therefore these values can be compared with the others (of course using the German perspective). The results are shown in Tab. 5 and Fig. 3.

Fig. 3: Results for Model Building 1 (semi-detached single-family house) – primary energy demand calculated according to the German regulations
(zero = requirements can not be complied, “-“ in Tab. 5)



³ “vereinfachtes Verfahren” nach EnEV 2007 Anlage 1, Nr. 3 / e_p nach DIN V 4701-10 Anhang C

Tab. 5: Results for Model Building 1 (semi-detached single-family house) – primary energy demand calculated according to the German regulations

variant name	basis	hg-cond	hg-pellet	hg-hp	dhw-el	dhw-sol	sys-el	vent-exh	vent-rec	sys-cond/sol/rec
variant type	basis	variation heat generator	variation heat generator	variation heat generator	variation hot water system	variation hot water system	variation heating & hot water system	variation ventilation	variation ventilation	variation heating, hot water and ventilation system
short description	low temperature boiler for heating and dhw, no vent. system	condensing boiler	wood pellet boiler	electric heat pump	decentral electric	thermal solar system	electric resistance system	exhaust ventilation system	ventilation system with heat recovery	condensing boiler + solar dhw system + ventilation system with heat recovery
Primary energy demand per sqm reference area* [kWh/(m ² a)]										
Germany	104	104	37	75	113	96	-	104	104	87
Austria	101	97	32	65	114	87	216	104	87	70
Czech Republic	111	106	35	70	124	97	238	114	96	79
Poland	114	109	35	72	127	100	245	117	99	82
Sweden (Lund)	87 ²⁾	83	31	68 ²⁾	-	92 ²⁾	- ²⁾	98 ³⁾	93	76
Denmark	-	94	31	63	106 ¹⁾	81 ¹⁾	209	85 ¹⁾	80 ¹⁾	67
UK (England & Wales)	-	99	35	72	101 ¹⁾	95 ¹⁾	194	105 ¹⁾	95 ¹⁾	82
The Netherlands	-	-	-	59	-	-	-	-	-	68
Belgium (Flanders)	103 ²⁾	118 ²⁾	32 ²⁾	83 ²⁾	108 ²⁾	101 ²⁾	-	103	87	94
Luxembourg	96	93	31	62	100	83	-	102	92	76
France (Alsace H1b)	108	113	34	77	108	94	231	111	93	89
relation to variant "basis" of Germany										
Germany	100%	100%	35%	72%	109%	92%	-	100%	100%	83%
Austria	97%	93%	31%	62%	110%	84%	208%	100%	83%	67%
Czech Republic	106%	102%	33%	68%	119%	93%	229%	109%	92%	76%
Poland	110%	105%	34%	70%	122%	96%	236%	112%	95%	79%
Sweden (Lund)	83% ²⁾	80%	30%	66% ²⁾	-	89% ²⁾	- ²⁾	94% ³⁾	89%	73%
Denmark	-	91%	30%	60%	102% ¹⁾	78% ¹⁾	201%	82% ¹⁾	77% ¹⁾	64%
UK (England & Wales)	-	95%	34%	69%	97% ¹⁾	92% ¹⁾	186%	101% ¹⁾	91% ¹⁾	78%
The Netherlands	-	-	-	57%	-	-	-	-	-	66%
Belgium (Flanders)	99% ²⁾	114% ²⁾	31% ²⁾	80% ²⁾	104% ²⁾	97% ²⁾	-	99%	84%	90%
Luxembourg	92%	89%	30%	59%	97%	80%	-	98%	88%	73%
France (Alsace H1b)	103%	109%	32%	74%	104%	90%	221%	106%	89%	86%

Remarks

*) calculated according to the rules of the German Energy Saving Ordinance (Energieeinsparverordnung EnEV 2007)

Deviations from the variant definition

1) condensing boiler (mandatory) in place of low temperature boiler

2) with exhaust ventilation system (mandatory)

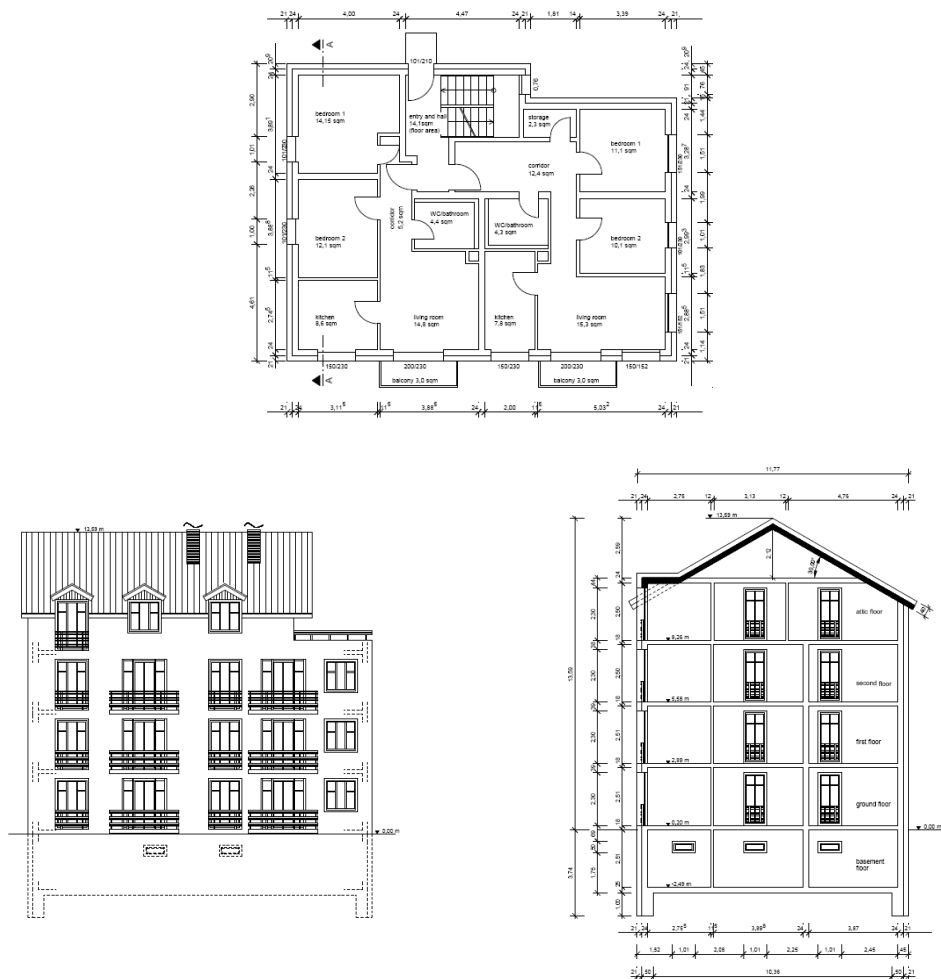
3) with an additional dhw heatpump

5 Model Building 2: multi-family house

5.1 Thermal Envelope

Model Building 2 is a multi-family house with 3 storeys plus conditioned attic storey. The cellar is not heated. The living area of the 7 apartments is 461 m² in total.

Fig. 4: Model Building 2 – multi-family house:
Overview of the building
 (the complete set of plans can be found in the Appendix)⁴



⁴ Source for the plans of this building: Kadir Durmaz: Modellrechnungen zur kommenden Energieeinsparverordnung. Vertiefearbeit an der TU Darmstadt. Supervisors: Susanne Schwickert (TUD) / Tobias Loga (IWU); TU Darmstadt August 2000 revised by Christina Kappich A-HP/Energie&Haus on behalf of IWU

Tab. 6: General building data / thermal envelope areas

Model building N° 2			according to	for comparison
Apartment house			German regulations	(simplified)
General building data				
floor area	ext. dim.	(inside therm. env.)	657,5 m ²	657,5 m ²
useful floor area	int. dim.	(inside therm. env.)	520,3 m ²	520,3 m ²
living area	int. dim.	(inside therm. env.)	461,2 m ²	461,2 m ²
building volume	ext. dim.	(inside therm. env.)	1936,7 m ³	1936,7 m ³
relation envelope surface area to building volume			0,517 m ² /m ³	0,517 m ² /m ³
Envelope surface area (ext. dim.)				
tilted roof			150,4 m ²	150,4 m ²
flat roof (terrace floor)			36,7 m ²	36,7 m ²
dormer roof			7,5 m ²	7,5 m ²
walls			454,4 m ²	454,4 m ²
dormer walls			4,4 m ²	4,4 m ²
cellar ceiling			158,2 m ²	173,5 m ²
floor to soil			15,3 m ²	0,0 m ²
walls to soil			18,0 m ²	0,0 m ²
walls to cellar			24,9 m ²	0,0 m ²
door to cellar			2,0 m ²	0,0 m ²
outside door			2,1 m ²	2,1 m ²
windows	East	vertical	45,7 m ²	45,7 m ²
	South	vertical	63,1 m ²	63,1 m ²
	West	vertical	18,6 m ²	18,6 m ²
sum envelope surface area			1001,3 m ²	956,4 m ²
ext. dim. = external dimensions				
int. dim. = internal dimensions				

According to the German regulations the stairwell is included in the thermal envelope. Since there is no door to the stair running down to the cellar the stairwell part of the cellar storey is considered to be heated as well. Therefore the thermal envelope in this area consists of the cellar floor of the stairwell, the walls bordering on soil as well as the walls and the door bordering on the cellar rooms. Since in some countries this is not considered in the same way a simplified envelope was defined for the determination of the simplified heat transfer coefficient used for comparison (see Tab. 6).

5.2 Types of supply systems

In order to avoid the problem which had occurred concerning the definition of the basis variant of the single family house (see 4.3) it was decided to change the variants definition for Model Building 2 in the following way:

- The new basis variant is a system with a condensing boiler for heating and hot water and an exhaust ventilation system.
- The variant "hg-cond" (condensing boiler) is replaced by "hg-bnc" (non-condensing boiler). This variant will not be calculated for countries in which non-condensing boilers are not allowed.
- The variant "vent-exh" (exhaust ventilation system) is replaced by "vent-nomec" (no mechanical ventilation). This variant will not be calculated for countries in which ventilation systems are mandatory.

In consequence the following supply systems were defined:

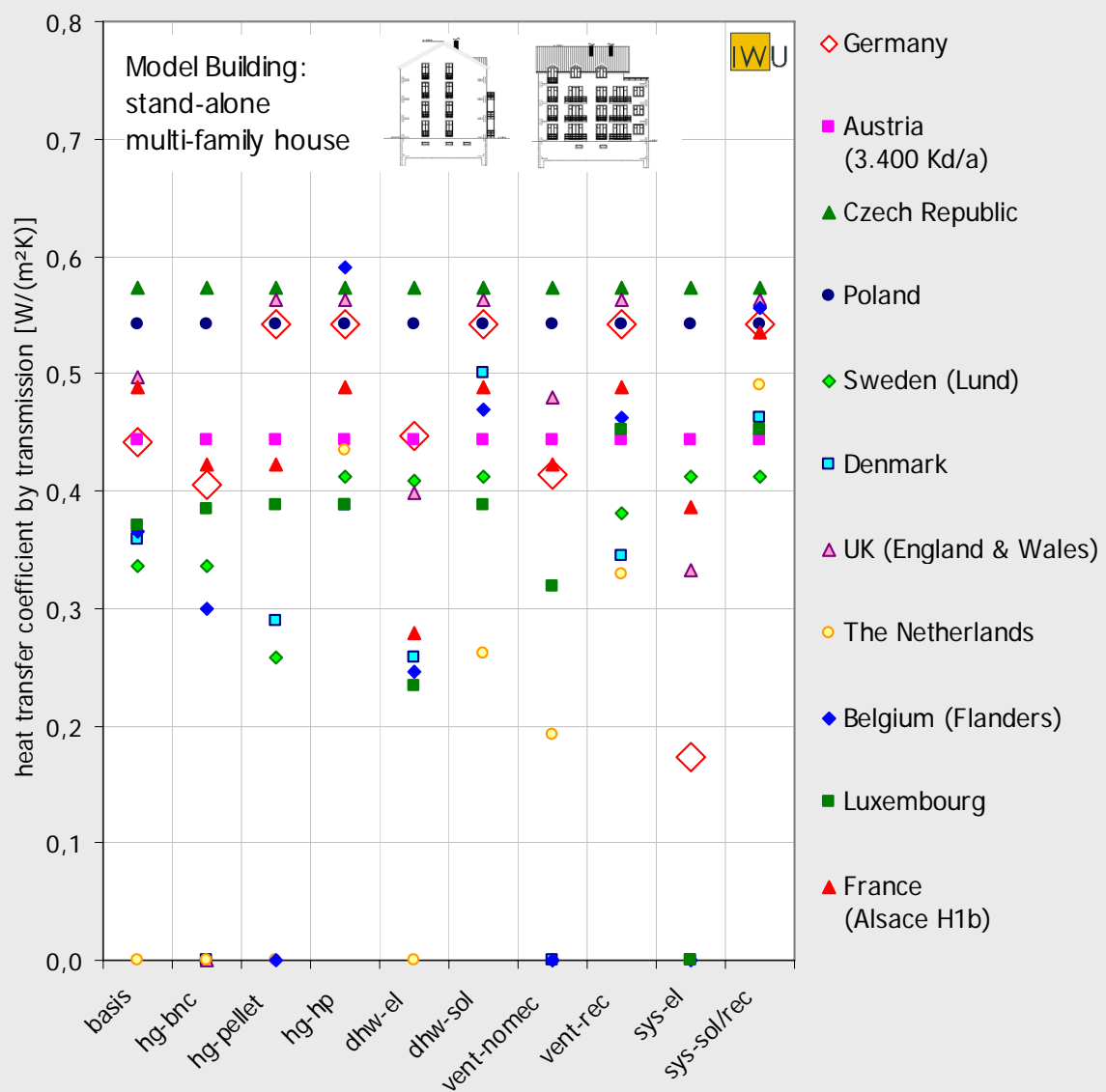
Tab. 7: Definition of the supply system variants

Label	Type	Varied component
basis	basis variant	central system with condensing boiler for heating and hot water, exhaust ventilation system
hg-bnc	variation heat generator	low temperatur boiler, non-condensing
hg-pellet	variation heat generator	wood pellet boiler
hg-hp	variation heat generator	electric heat pump
dhw-el	variation hot water system	decentral electric
dhw-sol	variation hot water system	thermal solar system
vent-nomec	variation ventilation	no mechanical ventilation system
vent-rec	variation ventilation	ventilation system with heat recovery
sys-el	variation heating, hot water and ventilation system	electric resistance system
sys-cond/sol/rec	variation heating, hot water and ventilation system	condensing boiler + solar dhw system + ventilation system with heat recovery

5.3 Results for the thermal quality of the envelope

The calculations of the thermal standard which just complies with the national requirements for new buildings was performed in the same way as for Model Building 1. The results are shown in Tab. 8 and in Fig. 5.

Fig. 5: Results for Model Building 2 (multi-family house) – simplified heat transfer coefficient by transmission (zero = requirements can not be complied, “-“ in Tab. 8)



Tab. 8: Results for Model Building 2 (multi-family house) – simplified heat transfer coefficient by transmission

variant name	basis	hg-bnc	hg-pellet	hg-hp	dhw-el	dhw-sol	vent-nomec	vent-rec	sys-el	sys-sol/rec
variant type	basis	variation heat generator	variation heat generator	variation heat generator	variation hot water system	variation hot water system	variation ventilation	variation ventilation	variation heating and hot water system	variation hot water and ventilation system
short description	condensing boiler for heating and hot water + exhaust ventilation system	low temperature boiler (non-condensing)	wood pellet boiler	electric heat pump	decentral electric	thermal solar system	no mechanical ventilation system	ventilation system with heat recovery	electric resistance system	solar dhw system + ventilation system with heat recovery
Heat transfer coefficient by transmission* [W/(m²K)]										
Germany	0,44	0,41	0,54	0,54	0,45	0,54	0,41	0,54	0,17	0,54
Austria (3.400 Kd/a)	0,44	0,44	0,44	0,44	0,44	0,44	0,44	0,44	0,44	0,44
Czech Republic	0,57	0,57	0,57	0,57	0,57	0,57	0,57	0,57	0,57	0,57
Poland	0,54	0,54	0,54	0,54	0,54	0,54	0,54	0,54	0,54	0,54
Sweden (Lund)	0,34	0,34	0,26	0,41	0,41	0,41	-	0,38	0,41	0,41
Denmark	0,36	-	0,29	0,39	0,26	0,50	-	0,34	-	0,46
UK (England & Wales)	0,50	-	0,56	0,56	0,40	0,56	0,48	0,56	0,33	0,56
The Netherlands	-	-	-	0,43	-	0,26	0,19	0,33	-	0,49
Belgium (Flanders)	0,37	0,30	-	0,59	0,25	0,47	-	0,46	-	0,56
Luxembourg	0,37	0,38	0,39	0,39	0,23	0,39	0,32	0,45	-	0,45
France (Alsace H1b)	0,49	0,42	0,42	0,49	0,28	0,49	0,42	0,49	0,39	0,54
relation to variant "basis" of Germany										
Germany	100%	92%	123%	123%	101%	123%	94%	123%	39%	123%
Austria (3.400 Kd/a)	101%	101%	101%	101%	101%	101%	101%	101%	101%	101%
Czech Republic	130%	130%	130%	130%	130%	130%	130%	130%	130%	130%
Poland	123%	123%	123%	123%	123%	123%	123%	123%	123%	123%
Sweden (Lund)	76%	76%	59%	93%	93%	93%	-	86%	93%	93%
Denmark	81%	-	66%	88%	58%	113%	-	78%	-	105%
UK (England & Wales)	112%	-	127%	127%	90%	127%	109%	127%	75%	127%
The Netherlands	-	-	-	98%	-	59%	44%	75%	-	111%
Belgium (Flanders)	83%	68%	-	134%	56%	106%	-	105%	-	126%
Luxembourg	84%	87%	88%	88%	53%	88%	72%	102%	-	102%
France (Alsace H1b)	111%	96%	96%	111%	63%	111%	96%	111%	87%	121%

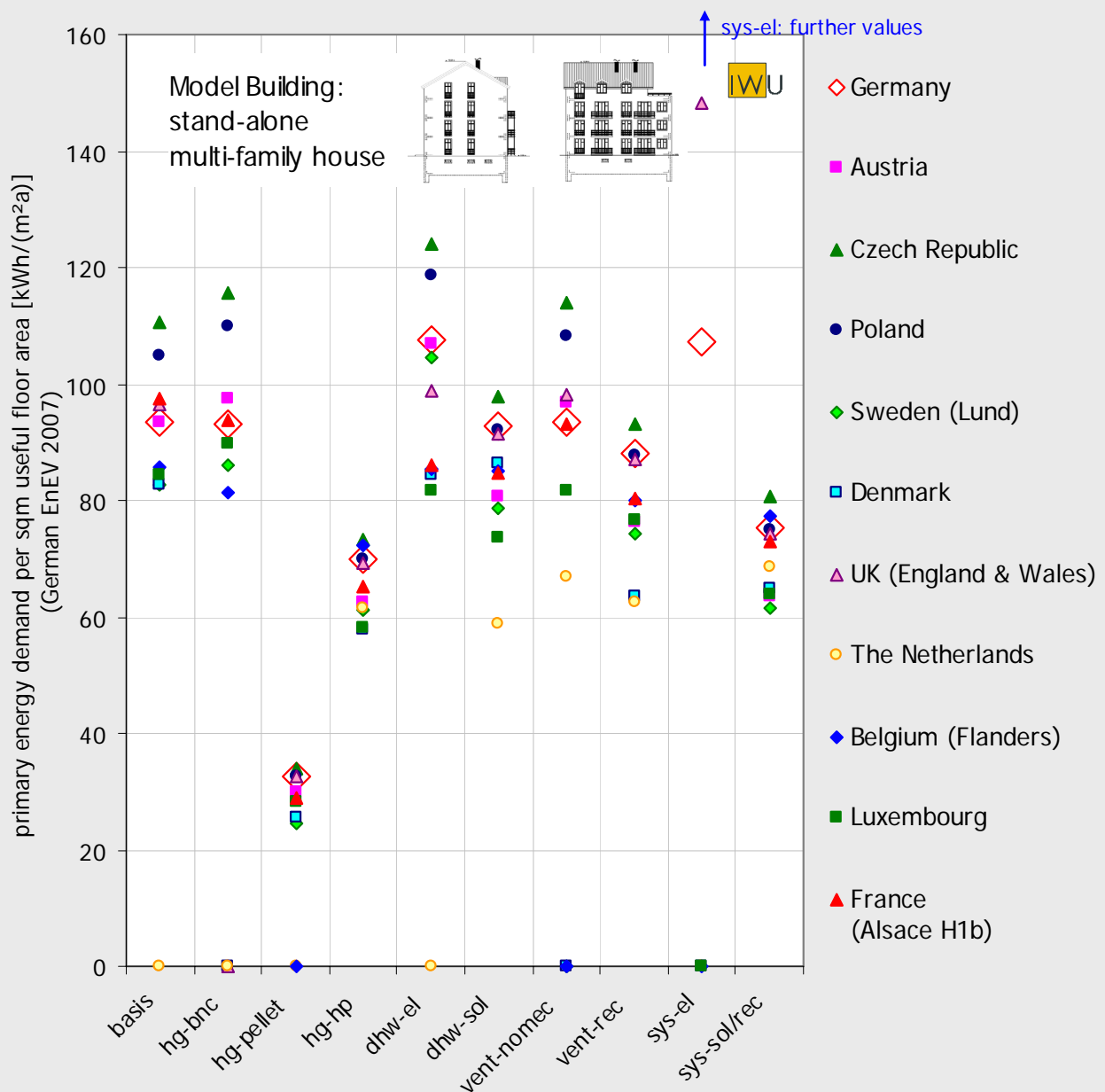
Remarks

*) considering transmission losses through thermal envelope areas determined by external dimensions, not explicitly considering possibly supplements or reductions by thermal bridging

5.4 Primary energy demand (according to German regulations)

Starting from the U-values for each variant from each country the primary energy demand was calculated according to the German Energy Saving Ordinance (EnEV 2007). The proceeding was the same as for Model Building 1 (see chapter 4.4). The results are shown in Tab. 9 and Fig. 6.

Fig. 6: Results for Model Building 2 (multi-family house) – primary energy demand calculated according to the German regulations
(zero = requirements can not be complied, “-“ in Tab. 9)



Tab. 9: Results for Model Building 2 (multi-family house) – primary energy demand calculated according to the German regulations

variant name	basis	hg-bnc	hg-pellet	hg-hp	dhw-el	dhw-sol	vent-nomec	vent-rec	sys-el	sys-sol/rec
variant type	basis	variation heat generator	variation heat generator	variation heat generator	variation hot water system	variation hot water system	variation ventilation	variation ventilation	variation heating and hot water system	variation hot water and ventilation system
short description	condensing boiler for heating and hot water + exhaust ventilation system	low temperature boiler (non-condensing)	wood pellet boiler	electric heat pump	decentral electric	thermal solar system	no mechanical ventilation system	ventilation system with heat recovery	electric resistance system	solar dhw system + ventilation system with heat recovery
Primary energy demand per sqm reference area* [kWh/(m²a)]										
Germany	93	93	33	70	108	93	93	88	107	75
Austria	93	98	30	62	107	81	97	76	185	63
Czech Republic	110	116	34	73	124	98	114	93	225	81
Poland	105	110	33	70	119	92	108	88	212	75
Sweden (Lund)	83	86	25	61	105	79	-	74	181	61
Denmark	83	-	25	58	84	86	-	64	-	65
UK (England & Wales)	96	-	32	69	99	91	98	87	148	74
The Netherlands	-	-	-	62	-	59	67	62	-	68
Belgium (Flanders)	86	81	-	72	85	85	-	80	-	77
Luxembourg	84	90	28	58	82	74	82	77	-	64
France (Alsace H1b)	97	94	29	65	86	85	93	80	167	73
relation to variant "basis" of Germany										
Germany	100%	100%	35%	75%	115%	99%	100%	95%	115%	81%
Austria	100%	105%	32%	67%	115%	86%	104%	82%	199%	68%
Czech Republic	118%	124%	36%	78%	133%	105%	122%	100%	241%	86%
Poland	112%	118%	35%	75%	127%	99%	116%	94%	228%	80%
Sweden (Lund)	89%	92%	26%	66%	112%	84%	-	80%	194%	66%
Denmark	88%	-	27%	62%	90%	93%	-	68%	-	69%
UK (England & Wales)	103%	-	35%	74%	106%	98%	105%	93%	159%	80%
The Netherlands	-	-	-	66%	-	63%	72%	67%	-	73%
Belgium (Flanders)	92%	87%	-	77%	92%	91%	-	86%	-	83%
Luxembourg	90%	96%	30%	62%	88%	79%	88%	82%	-	69%
France (Alsace H1b)	104%	100%	31%	70%	92%	91%	100%	86%	179%	78%

Remarks

*) calculated according to the rules of the German Energy Saving Ordinance (Energieeinsparverordnung EnEV 2007)

6 Model Building 3: School

6.1 Thermal envelope

Model Building 3 is a two storey school building with about 2700 m² net floor area. It has a flat roof, a cellar is not existent. An overview of the building geometry is given by Fig. 7. In Tab. 10 the surface areas of the thermal envelope elements determined by use of external dimensions are listed. The complete set of plans and the details of the envelope area calculation can be found in the Appendix.

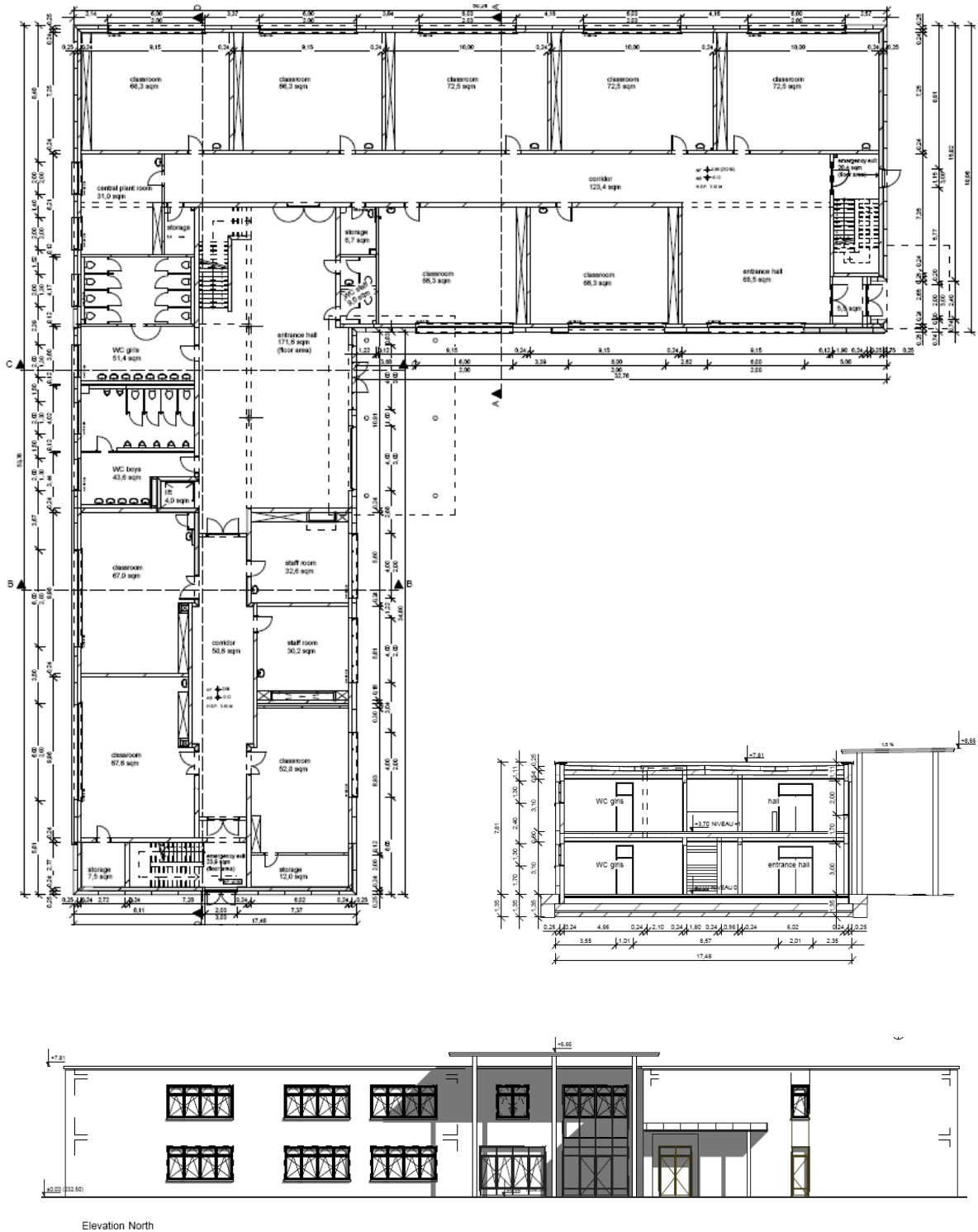
Tab. 10: General building data / thermal envelope areas

Model building N° 3			
school building			
General building data			
gross floor area	ext. dim.	(inside therm. env.)	3121,7 m ²
net floor area	int. dim.	(inside therm. env.)	2724,9 m ²
useful floor area	int. dim.	(inside therm. env.)	1876,2 m ²
building volume	ext. dim.	(inside therm. env.)	13891,1 m ³
relation envelope surface area to building volume			0,358 m ² /m ³
Envelope surface area (ext. dim.)			
roof			1560,9 m ²
wall N			324,1 m ²
wall E			310,4 m ²
wall S			335,1 m ²
wall W			272,4 m ²
wall to soil N			58,6 m ²
wall to soil E			54,8 m ²
wall to soil S			58,6 m ²
wall to soil W			54,8 m ²
window N			84,0 m ²
window E			76,0 m ²
window S			84,8 m ²
window W			120,0 m ²
door N			11,8 m ²
door E			6,0 m ²
floor			1560,9 m ²
sum envelope surface area			4973,2 m ²

ext. dim. = external dimensions

int. dim. = internal dimensions

Fig. 7: Model Building 3 – school:
Overview of the building
 (the complete set of plans can be found in the Appendix) ⁵



⁵ Source for the plans of this building: Atelier d'Architecture Arlette Feierstein, Luxembourg revised by Christina Kappich A-HP/Energie&Haus on behalf of IWU

6.2 Types of supply systems

A central heating system with a condensing gas boiler is defined as the basis variant. The heat generator is installed in a central heating room. The heating room and all heat ducts are located inside of the thermal envelope. The two lavatories are very close to the central heating room and are supplied with hot water by circulation pipes. In the class rooms conventional radiators are installed for heat emission. In order to make sure that the basis variant can be realised in all countries a ventilation system with heat recovery is considered.

Starting from this basis system variations are defined: Instead of the condensing boiler a low temperature gas boiler (non-condensing), an electric heat pump and a wood pellet boiler are used for heat generation. In a further variant the ventilation system is omitted.

The details of the supply system variants (system temperatures, duct lengths, thermal and electric power, ...) are documented in the Appendix.

Tab. 11: Definition of the supply system variants

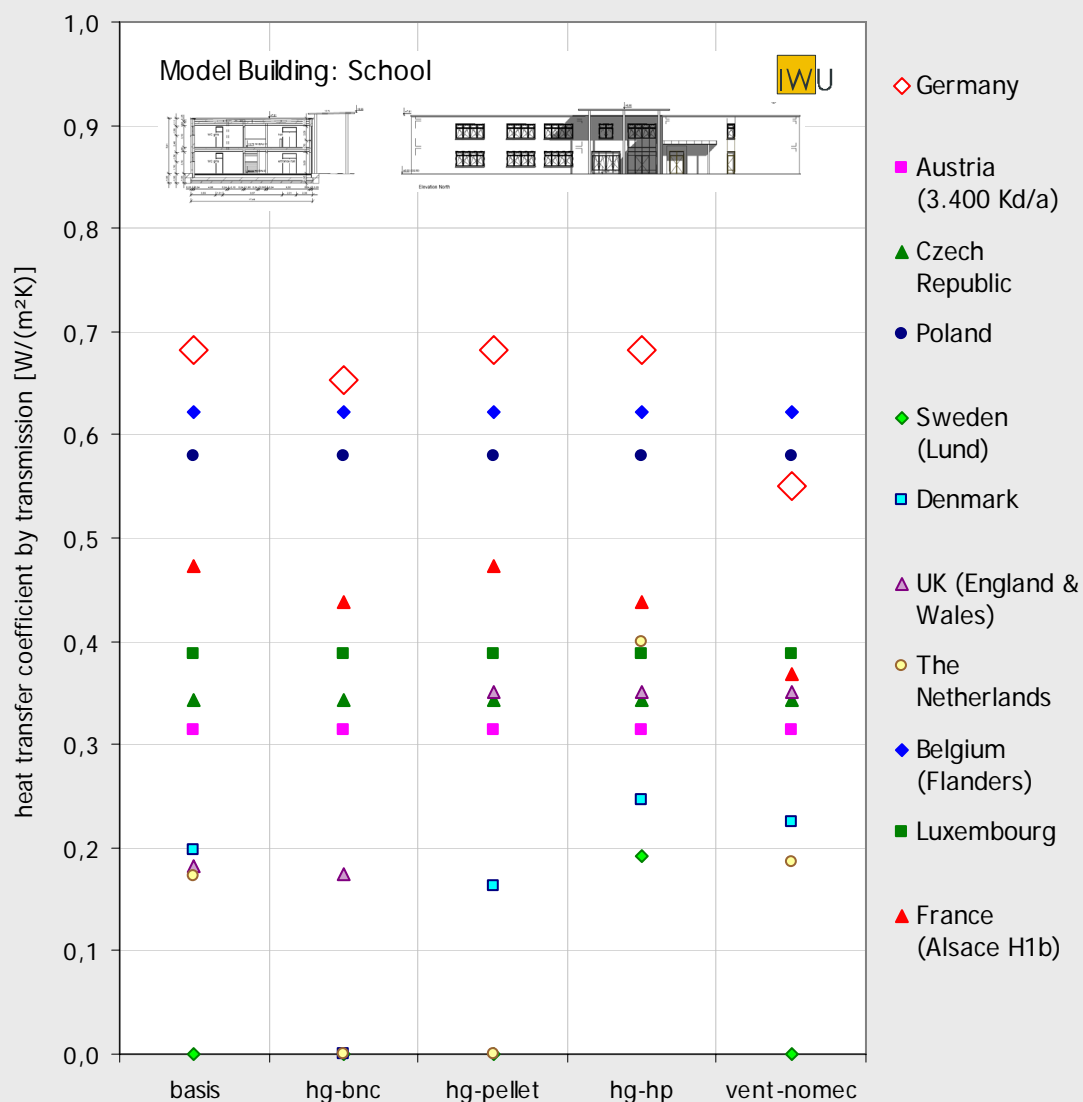
Label	Type	Varied component
basis	basis variant	condensing boiler for heating and hot water + exhaust ventilation system
hg-bnc	variation heat generator	low temperature boiler (non-condensing)
hg-pellet	variation heat generator	wood pellet boiler
hg-hp	variation heat generator	electric heat pump (soil)
vent-nomec	variation ventilation	no mechanical ventilation system

6.3 Results for the thermal quality of the envelope

The calculations of the thermal standard which just complies with the national requirements for new buildings was performed in the same way as for Model Building 1 and 2. The results are shown in Tab. 12 and in Fig. 8. Information about the calculation methods which were used in the different countries can be found in the “Country Sheets” (Appendix).

The lowest values can be found for the countries Sweden, UK, Denmark and the Netherlands. Similar to the previous example buildings the missing values (indicated by “-“ in the table) are caused by the fact that the U-values have to be reduced below a level which can be realised in practice (U-value of opaque elements $< 0,08 \text{ W}/(\text{m}^2\text{K})$ / of windows $< 0,8 \text{ W}/(\text{m}^2\text{K})$). In case of Sweden the requirements are so severe that only one of the five variants could be built.

Fig. 8: Results for Model Building 3 (school) – simplified heat transfer coefficient by transmission
(zero = requirements can not be complied, “-“ in Tab. 12)



Tab. 12: Results for Model Building 3 (school) – simplified heat transfer coefficient by transmission

variant name	basis	hg-bnc	hg-pellet	hg-hp	vent-nomec
variant type	basis	variation heat generator	variation heat generator	variation heat generator	variation ventilation
short description	condensing boiler for heating and hot water + exhaust ventilation system	low temperature boiler (non-condensing)	wood pellet boiler	electric heat pump	no mechanical ventilation system
	Heat transfer coefficient by transmission* [W/(m²K)]				
Germany	0,68	0,65	0,68	0,68	0,55
Austria (3.400 Kd/a)	0,31	0,31	0,31	0,31	0,31
Czech Republic	0,34	0,34	0,34	0,34	0,34
Poland	0,58	0,58	0,58	0,58	0,58
Sweden (Lund)	-	-	-	0,19	-
Denmark	0,20	-	0,16	0,25	0,23
UK (England & Wales)	0,18	0,17	0,35	0,35	0,35
The Netherlands	0,17	-	-	0,40	0,19
Belgium (Flanders)	0,62	0,62	0,62	0,62	0,62
Luxembourg	0,39	0,39	0,39	0,39	0,39
France (Alsace H1b)	0,47	0,44	0,47	0,44	0,37
	relation to variant "basis" of Germany				
Germany	100%	96%	100%	100%	81%
Austria (3.400 Kd/a)	46%	46%	46%	46%	46%
Czech Republic	50%	50%	50%	50%	50%
Poland	85%	85%	85%	85%	85%
Sweden (Lund)	-	-	-	28%	-
Denmark	29%	-	24%	36%	33%
UK (England & Wales)	27%	26%	52%	52%	52%
The Netherlands	25%	-	-	58%	27%
Belgium (Flanders)	91%	91%	91%	91%	91%
Luxembourg	57%	57%	57%	57%	57%
France (Alsace H1b)	69%	64%	69%	64%	54%

Remarks

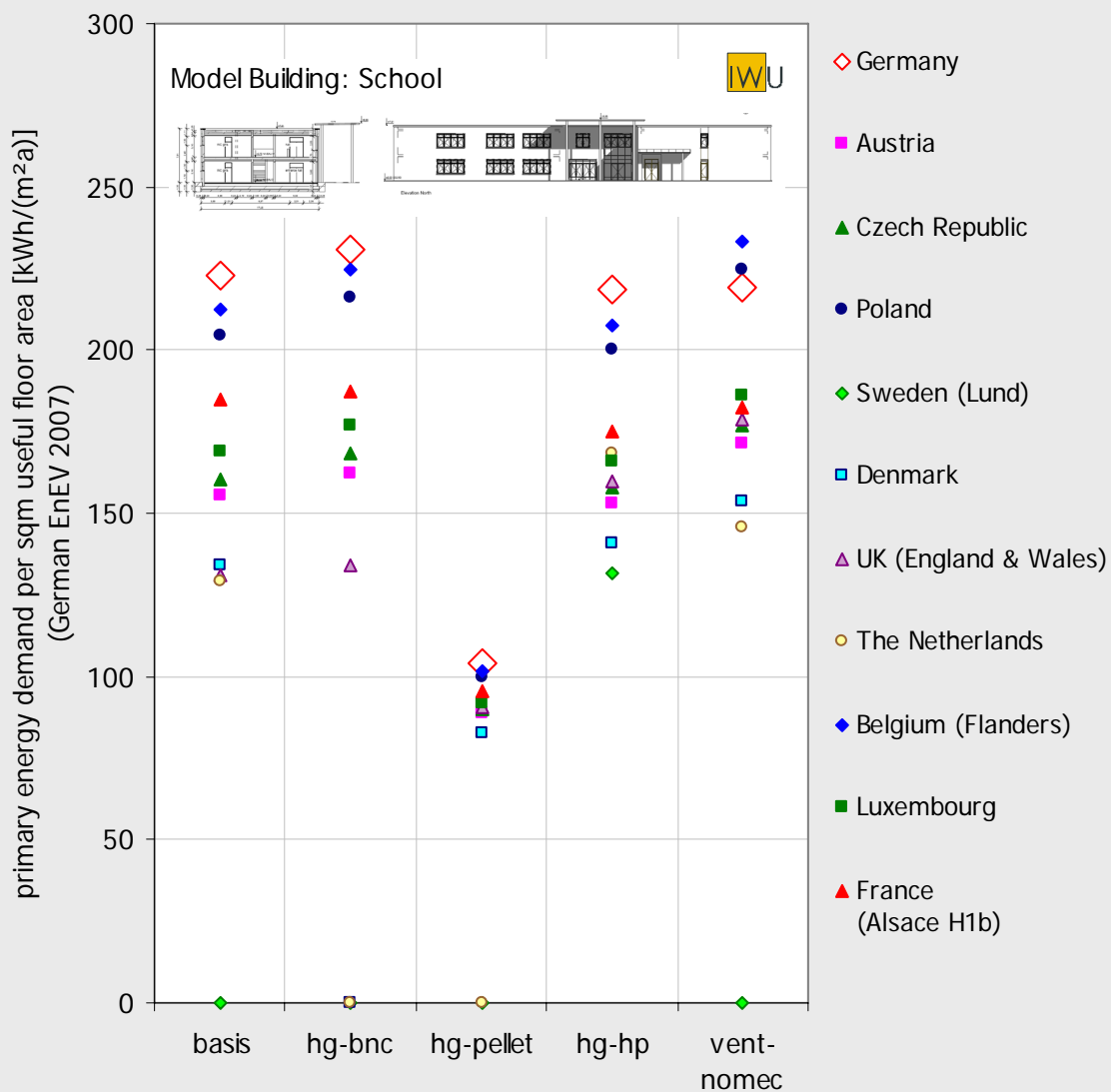
*) considering transmission losses through thermal envelope areas determined by external dimensions, not explicitly considering possibly supplements or reductions by thermal bridging

6.4 Primary energy demand (according to German regulations)

Starting from the U-values for each variant from each country the primary energy demand was calculated according to the German Energy Saving Ordinance (EnEV 2007, calculation procedure DIN V 18599, 1 zone building). The results are shown in Tab. 13 and Fig. 9.

The results are in principle similar to the previous ones. The poorest requirements can be found in Germany, the severest in Sweden.

Fig. 9: Results for Model Building 3 (school) – primary energy demand calculated according to the German regulations
(zero = requirements can not be complied, “-“ in Tab. 13)



**Tab. 13: Results for Model Building 3 (school) –
primary energy demand calculated according to the German regulations**

variant name	basis	hg-bnc	hg-pellet	hg-hp	vent-nomec
variant type	basis	variation heat generator	variation heat generator	variation heat generator	variation ventilation
short description	condensing boiler for heating and hot water + exhaust ventilation system	low temperature boiler (non-condensing)	wood pellet boiler	electric heat pump	no mechanical ventilation system
	Primary energy demand per sqm reference area* [kWh/(m²a)]				
Germany	223	231	104	218	219
Austria	155	162	89	153	171
Czech Republic	161	168	90	158	177
Poland	204	216	100	200	225
Sweden (Lund)	-	-	-	132	-
Denmark	134	-	82	141	154
UK (England & Wales)	131	134	90	160	179
The Netherlands	129	-	-	168	146
Belgium (Flanders)	212	225	102	208	233
Luxembourg	169	177	92	166	186
France (Alsace H1b)	185	187	96	175	182
	relation to variant "basis" of Germany				
Germany	100%	104%	47%	98%	98%
Austria	70%	73%	40%	69%	77%
Czech Republic	72%	75%	40%	71%	79%
Poland	92%	97%	45%	90%	101%
Sweden (Lund)	-	-	-	59%	-
Denmark	60%	-	37%	63%	69%
UK (England & Wales)	59%	60%	41%	72%	80%
The Netherlands	58%	-	-	75%	65%
Belgium (Flanders)	95%	101%	46%	93%	105%
Luxembourg	76%	79%	41%	74%	83%
France (Alsace H1b)	83%	84%	43%	78%	82%

Remarks

*) calculated according to the rules of the German Energy Saving Ordinance (Energieeinsparverordnung EnEV 2007)

7 Résumé

The here performed investigations give an impression of the energy performance requirements of new buildings in Germany and the 10 neighboured countries Austria, Czech Republic, Poland, Sweden, Denmark, UK, Netherlands, Belgium (Flanders), Luxembourg and France. The results which are to be considered as exemplary show certain tendencies: Regarding the two residential buildings the German requirements (EnEV 2007) are settled on a more or less average level. The best energy performance is achieved by the regulations in the Netherlands, Sweden, Denmark and Luxembourg. Especially the German requirements on the thermal transmittance of the envelope turned out to be comparably poor. It is the restricting limit in cases of supply systems with high efficiency or biomass. In case of the school building the German energy performance level is the poorest of all considered countries - for nearly all variants. The most ambitious requirements can be found in UK, Netherlands, Sweden and Denmark.

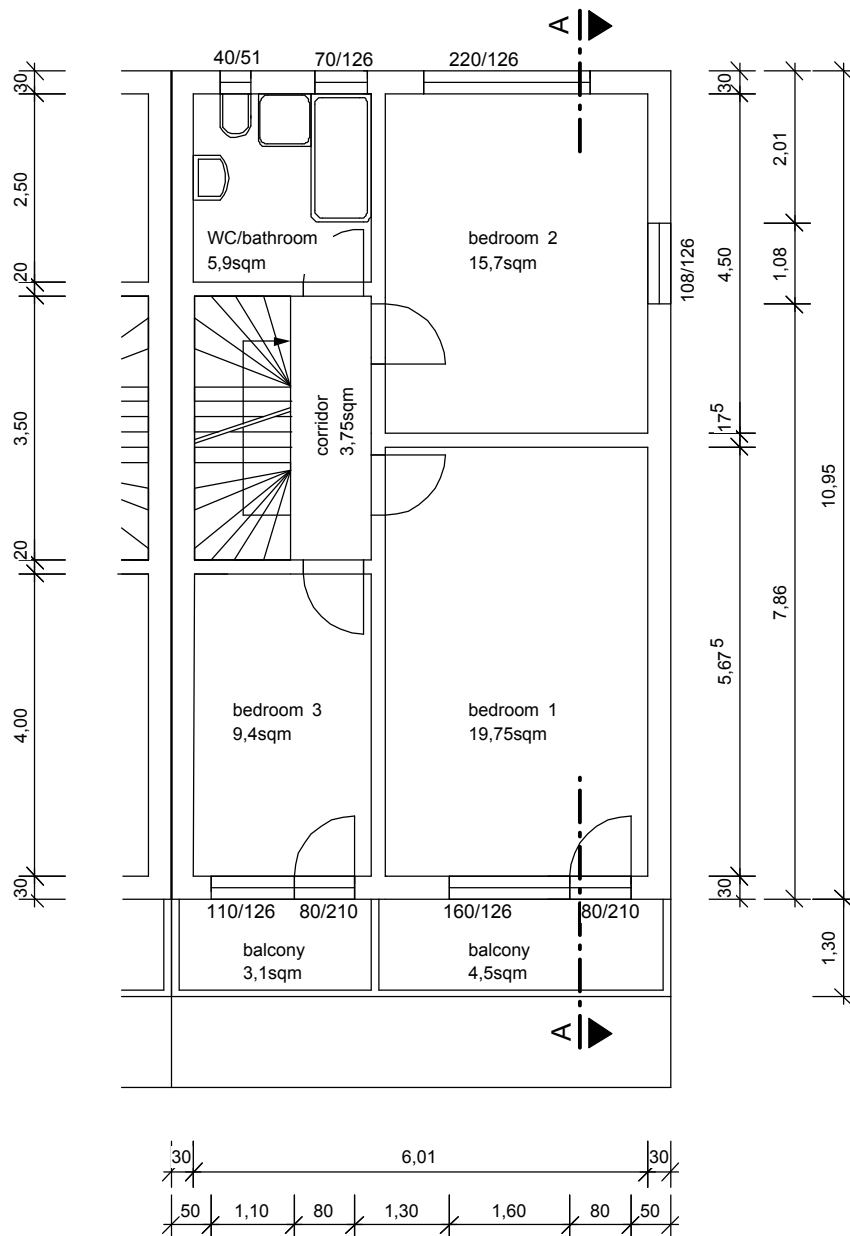
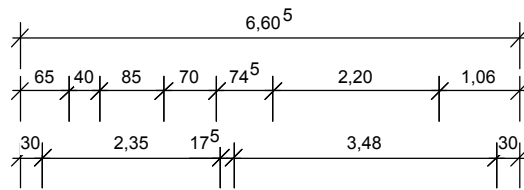
Facing the fact that an analytic comparison of the national methods was not a subject of this study the reasons for the dependencies of the different parameters can not be explained in detail. With regard to the objective of this study – the determination of the requirement level for a considerable number of countries – the applied method proved its worth. The documented building examples show how plans and tabled descriptions can be designed in order to make possible the application of national methods by experts from different countries. From this experience a two-step approach can be recommended for future investigations: In a first step the supply system of the basis variant should be selected in co-operation with the involved partners making sure that the respective building-system combination can be realised in all countries. Usually this will result in the selection of a more efficient supply system. Based on this reference case the parameter variations can be performed in a concerted way – omitting a variant in case that it cannot be built in a certain country.

Since primary energy demand and carbon dioxide emissions are defined differently in the national regulations (especially regarding biomass) these quantities are not adequate for a comprehensive cross-country comparison of the overall energy performance. They can only be used in a single country for illuminating comparison results by applying the national definition framework. The primary energy values shown in this study can therefore be considered as translation to understand the results from the viewpoint of the German energy saving ordinance and are addressing especially German experts. On an international level the simplified transfer coefficient by transmission has proved to be a good comparison criterion which gives – being a sort of average U-value – an indication of the “insulation quality” for a given building geometry and its supply system. However, the application of this method is restricted to countries with similar climates and to building types with an energy consumption that considerably depends on the thermal transmittance of the envelope.

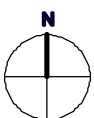
APPENDIX

Appendix 1: Definition of Model Building 1 – semi-detached single family house

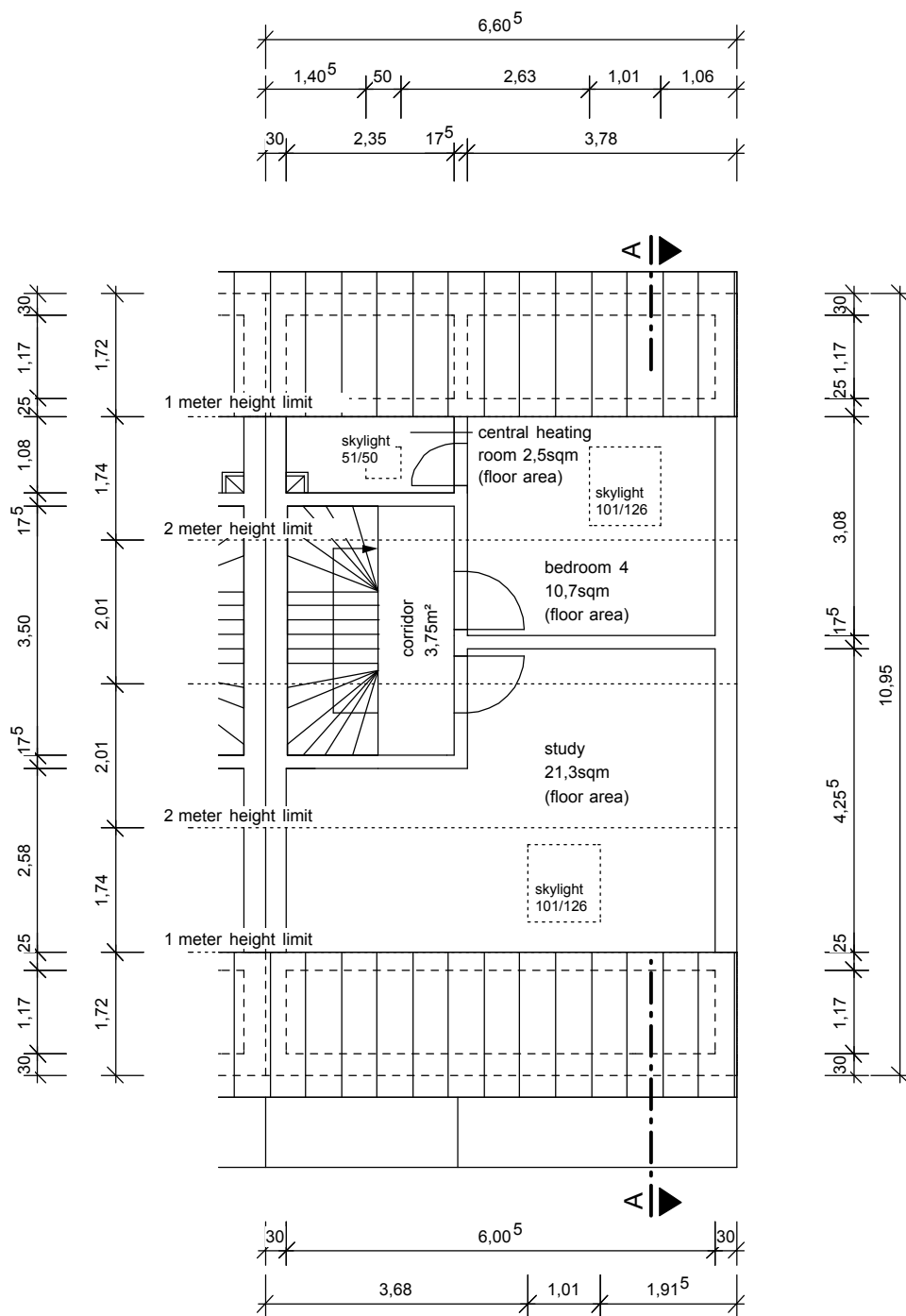
Appendix 1a: Plans



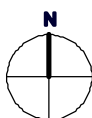
IWU 2008



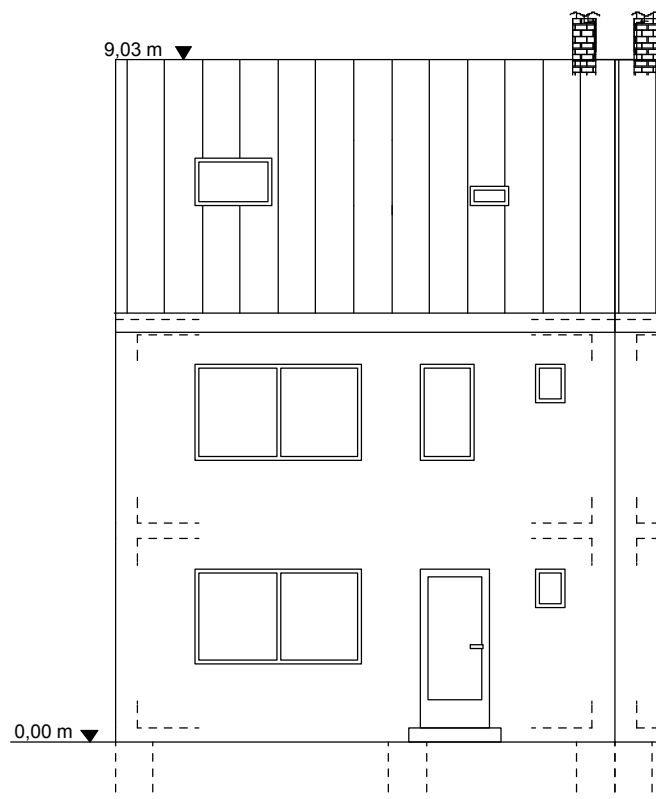
Building	END-TERRACE HOUSE
Floor Plan	First Floor
Scale	1:100
Date	Jan 2008



IWU 2008

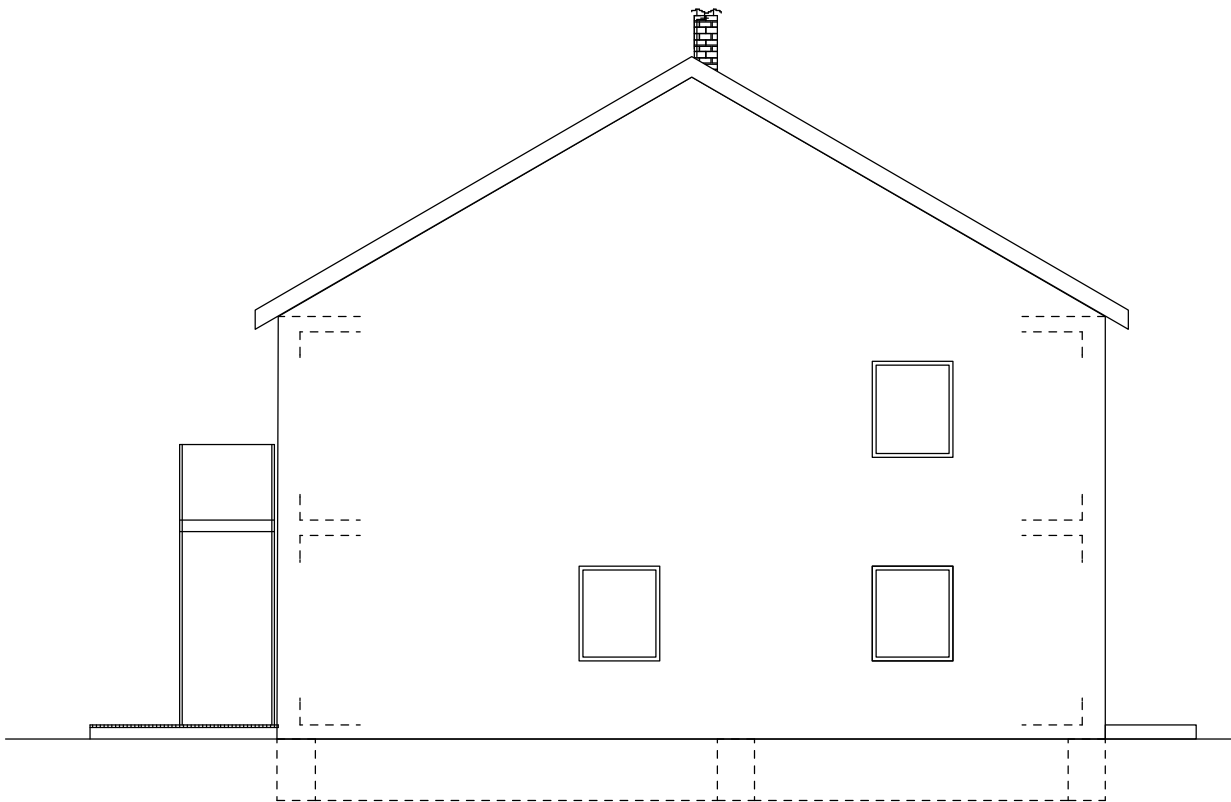


Building	END-TERRACE HOUSE
Floor Plan	Attic Floor
Scale	1:100
Date	Jan 2008



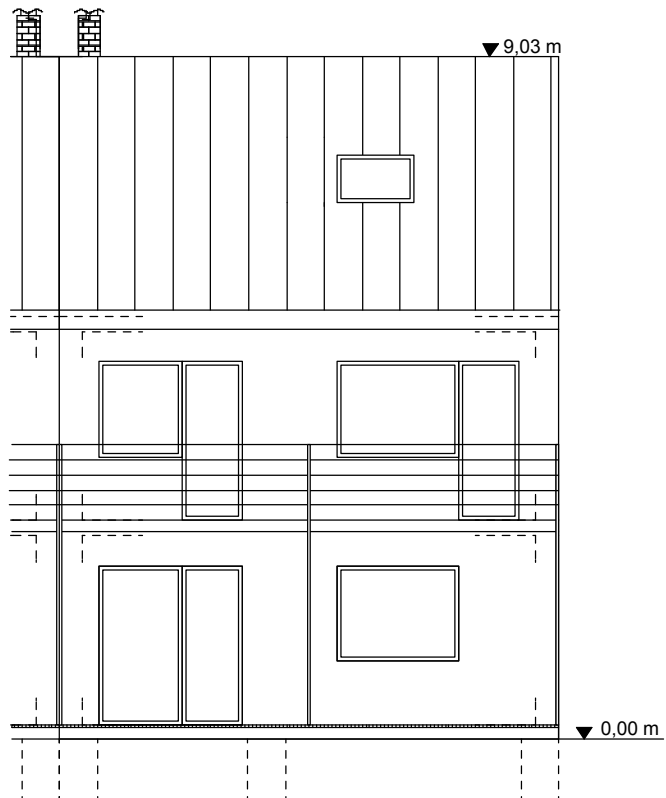
IWU 2008

Building	END-TERRACE HOUSE
Plan	Elevation North
Scale	1:100
Date	Jan 2008



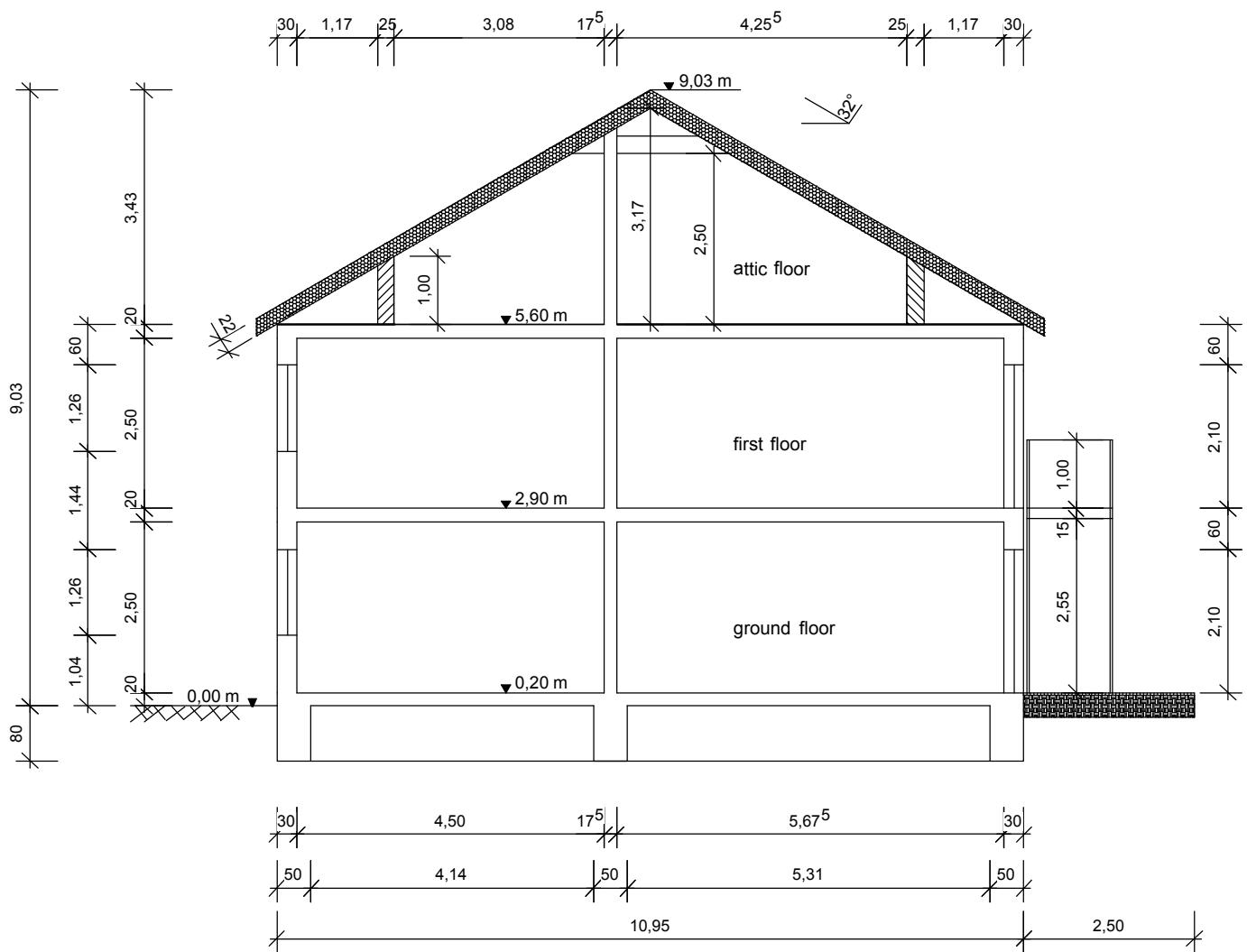
IWU 2008

Building	END-TERRACE HOUSE
Plan	Elevation East
Scale	1:100
Date	Jan 2008



IWU 2008

Building	END-TERRACE HOUSE
Plan	Elevation South
Scale	1:100
Date	Jan 2008



IWU 2008

Building	END-TERRACE HOUSE
Plan	Section A - A
Scale	1:100
Date	Jan 2008

Appendix 1b: Detailed envelope area calculation (external dimensions)

	name area element (free)	further specification / location	dedicated envelope area type	dedicated orientation for windows	reductio n area: insert "R"	width	length	height	gross surface area	net surface area
						[m]	[m]	[m]	[m²]	[m²]
1.	floor above soil		floor			6,605	10,95			72,3
2.	wall N	front side	wall				6,605	5,86	38,7	30,0
3.	door N	front side	door		R	0,90		2,10		1,9
4.	window N 1	North / ground floor	window	N	R	2,20		1,26		2,8
5.	window N 2	North / ground floor	window	N	R	0,40		0,51		0,2
6.	window N 3	North / first floor	window	N	R	2,20		1,26		2,8
7.	window N 4	North / first floor	window	N	R	0,70		1,26		0,9
8.	window N 5	North / first floor	window	N	R	0,40		0,51		0,2
9.	wall S	South	wall				6,605	5,86	38,7	25,9
10.	window S 1	South / ground floor	window	S	R	1,90		2,10		4,0
11.	window S 2	South / ground floor	window	S	R	1,60		1,26		2,0
12.	window S 3	South / first floor	window	S	R	1,10		1,26		1,4
13.	window S 4	South / first floor	window	S	R	0,80		2,10		1,7
14.	window S 5	South / first floor	window	S	R	1,60		1,26		2,0
15.	window S 6	South / first floor	window	S	R	0,80		2,10		1,7
16.	wall E 1	East / ground floor + first floor	wall				10,95	5,86	64,2	60,1
17.	window E 1	East / ground floor	window	E	R		1,08	1,26		1,4
18.	window E 2	East / ground floor	window	E	R		1,08	1,26		1,4
19.	window E 3	East / first floor	window	E	R		1,08	1,26		1,4
20.	wall E 2	East / attic floor	wall				10,95	1,585		17,4
21.	roof N	North	roof			6,605	6,461		42,7	41,1
22.	skylight window N 1	North	window	N_45	R	0,51	0,50			0,3
23.	skylight window N 2	North	window	N_45	R	1,01	1,26			1,3
24.	roof S	South	roof			6,605	6,461		42,7	41,4
25.	skylight window S	South	window	S_45	R	1,01	1,26			1,3
Gesamt thermische Hülle:										316,6

Appendix 1c: Definition of the supply system types

Explanation of table colours:

green = basic definition of the system

blue = to be used only if necessary; if not compatible to the national definitions or values the most similar ones were to be used

Variants basis, hg-cond, hg-pellet, hg-hp, dhw-el, dhw-sol

variant

variant N°

variant name

variant type

short description

building

thermal envelope

envelope surface area

thermal bridges

air-tightness

solar gains

total solar energy transmittance (for radiation perpendicular to the glazing)

external shading correction factor (all directions)

alternatively: horizon angle

frame area fraction of windows

heating system

heat generation (heating)

type

energy carrier

location

control temperature

further specification

thermal power

heat distribution (heating)

type

location

control temperature

electric consumption pump

heating pipes (if detailed input required)

string 1

pipe length

insulation thickness

alternatively: U-value

string 2

pipe length

insulation thickness

alternatively: U-value

string 3

pipe length

insulation thickness

alternatively: U-value

heat emission (heating)

type

control

1-0	1-11	1-12	1-13	1-21	1-22
basis	hg-cond	hg-pellet	hg-hp	dhw-el	dhw-sol
basis	variation heat generator	variation heat generator	variation heat generator	variation hot water system	variation hot water system
low temperature boiler	condensing boiler	wood pellet boiler	electric heat pump	decentral electric	thermal solar system
definition see plans (+ table with outside envelope areas, if app no relevant constructive thermal bridges)					
no blower door measurement	no blower door measurement	no blower door measurement	no blower door measurement	no blower door measurement	no blower door measurement
				0,6	
				0,6	
				30°	
				0,3	
low temperature boiler (not condensing)	condensing boiler	pellet boiler	electric heat pump (soil/water)	= var. 1-0	= var. 1-0
natural gas	natural gas	wood pellets	electricity	= var. 1-0	= var. 1-0
central heating room (attic)	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
adjusted in dependence of outdoor temperature	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
maximum values for supply / return temperature: 70°C / 55°C	= var. 1-0	= var. 1-0	maximum values for supply / return temperature: 55°C / 45°C	= var. 1-0	= var. 1-0
18 kW	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
water pipes	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
completely inside of the thermal envelope, vertical central string	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
control of heat distribution temperature according to outdoor air temperature	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
electric power = 80 W / running time = 18 h/d x 365 d/a	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
main string / heating room	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
2 x 2 m	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
20 mm	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
0,20 W/(m²K)	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
main string / vertical	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
2 x 6 m	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
20 mm	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
0,20 W/(m²K)	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
distribution in rooms	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
2 x 60 m	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
-	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
0,40 W/(m²K)	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
radiators	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
thermostatic valves (regulation range: 2K)	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0

variant

variant N°

variant name

variant type

short description

hot water system**heat generation**

type

energy carrier

location

further specification

heat storage

type

location

volume

heat loss per day

heat distribution

type

location

temperature

electric consumption pump

heating pipes (if detailed input required)**string 1**

pipe length

insulation thickness

alternatively: U-value

string 2

pipe length

insulation thickness

alternatively: U-value

string 3

pipe length

insulation thickness

alternatively: U-value

ventilation system

type

specification

1-0	1-11	1-12	1-13	1-21	1-22
basis	hg-cond	hg-pellet	hg-hp	dhw-el	dhw-sol
basis	variation heat generator	variation heat generator	variation heat generator	variation hot water system	variation hot water system
low temperature boiler	condensing boiler	wood pellet boiler	electric heat pump	decentral electric	thermal solar system
combined with heat generator for space heating (see above)	combined with heat generator for space heating (see above)	combined with heat generator for space heating (see above)	combined with heat generator for space heating (see above)	electric water heaters	combined with heat generator for space heating (see above) + additional thermal solar system
(see above)	(see above)	(see above)	(see above)	electricity	(see above)
(see above)	(see above)	(see above)	(see above)	inside thermal envelope	(see above)
hot water storage	= var. 1-0	= var. 1-0	= var. 1-0	none	= var. 1-0
central heating room (attic)	= var. 1-0	= var. 1-0	= var. 1-0	-	= var. 1-0
120 liter	= var. 1-0	= var. 1-0	= var. 1-0	-	400 liter
1,75 kWh/d	= var. 1-0	= var. 1-0	= var. 1-0	-	2,6 kWh/d
without hot water circulation	= var. 1-0	= var. 1-0	= var. 1-0	without hot water circulation	= var. 1-0
completely inside of the thermal envelope, vertical central string	= var. 1-0	= var. 1-0	= var. 1-0	in the kitchen and in the bathroom	= var. 1-0
60°C	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
-	= var. 1-0	= var. 1-0	= var. 1-0	none	= var. 1-0
main string / heating room	= var. 1-0	= var. 1-0	= var. 1-0	none	= var. 1-0
2 m	= var. 1-0	= var. 1-0	= var. 1-0	-	= var. 1-0
10 mm	= var. 1-0	= var. 1-0	= var. 1-0	-	= var. 1-0
0,30 W/(m²K)	= var. 1-0	= var. 1-0	= var. 1-0	-	= var. 1-0
main string / vertical	= var. 1-0	= var. 1-0	= var. 1-0	none	= var. 1-0
6 m	= var. 1-0	= var. 1-0	= var. 1-0	-	= var. 1-0
10 mm	= var. 1-0	= var. 1-0	= var. 1-0	-	= var. 1-0
0,30 W/(m²K)	= var. 1-0	= var. 1-0	= var. 1-0	-	= var. 1-0
distribution in kitchen and in bathroom / WC	= var. 1-0	= var. 1-0	= var. 1-0	distribution in kitchen and in bathroom / WC	= var. 1-0
10 m	= var. 1-0	= var. 1-0	= var. 1-0	10 m	= var. 1-0
-	= var. 1-0	= var. 1-0	= var. 1-0	-	= var. 1-0
0,40 W/(m²K)	= var. 1-0	= var. 1-0	= var. 1-0	0,40 W/(m²K)	= var. 1-0
none	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
none	none	none	none	none	none

Variants basis, sys-el, vent-exh, vent-rec, sys-cond/sol/rec

variant

variant N°

variant name

variant type

short description

building

thermal envelope

envelope surface area

thermal bridges

air-tightness

solar gains

total solar energy transmittance (for radiation perpendicular to the glazing)
external shading correction factor (all directions)

alternatively: horizon angle

frame area fraction of windows

heating system

heat generation (heating)

type

energy carrier

location

control temperature

further specification

thermal power

heat distribution (heating)

type

location

control temperature

electric consumption pump

heating pipes (if detailed input required)

string 1

pipe length

insulation thickness

alternatively: U-value

string 2

pipe length

insulation thickness

alternatively: U-value

string 3

pipe length

insulation thickness

alternatively: U-value

heat emission (heating)

type

control

1-0	1-31	1-41	1-42	1-51
basis	sys-el	vent-exh	vent-rec	sys-cond/sol/rec
basis	variation heating & hot water system	variation ventilation	variation ventilation	variation heating & hot water system
low temperature boiler	electric resistance system	exhaust ventilation system	ventilation system with heat recovery	condensing boiler + solar dhw system + ventilation system with heat recovery
definition see plans (+ table with outside envelope areas, if applicable)				
no relevant constructive thermal bridges				
no blower door measurement	no blower door measurement	blower door measurement: n50 $\leq 1,5 \text{ h}^{-1}$	blower door measurement: n50 $\leq 1,5 \text{ h}^{-1}$	blower door measurement: n50 $\leq 1,5 \text{ h}^{-1}$
0,6				
0,6				
30°				
0,3				
low temperature boiler (not condensing)	electric heated water storage	= var. 1-0	= var. 1-0	condensing boiler
natural gas	electricity	= var. 1-0	= var. 1-0	natural gas
central heating room (attic)	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
adjusted in dependence of outdoor temperature	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
maximum values for supply / return temperature: 70°C / 55°C	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
18 kW	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
water pipes	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
completely inside of the thermal envelope, vertical central string	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
control of heat distribution temperature according to outdoor air temperature	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
electric power = 80 W / running time = 18 h/d x 365 d/a	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
main string / heating room	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
2 x 2 m	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
20 mm	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
0,20 W/(m²K)	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
main string / vertical	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
2 x 6 m	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
20 mm	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
0,20 W/(m²K)	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
distribution in rooms	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
2 x 60 m	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
-	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
0,40 W/(m²K)	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
radiators	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
thermostatic valves (regulation range: 2K)	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0

variant

variant N°
variant name
variant type

short description

hot water system**heat generation**

type

energy carrier

location

further specification

heat storage

type

location

volume

heat loss per day

heat distribution

type

location

temperature

electric consumption pump

heating pipes (if detailed input required)**string 1**

pipe length
insulation thickness
alternatively: U-value

string 2

pipe length
insulation thickness
alternatively: U-value

string 3

pipe length
insulation thickness
alternatively: U-value

ventilation system

type

specification

1-0	1-31	1-41	1-42	1-51
basis	sys-el	vent-exh	vent-rec	sys-cond/sol/rec
basis	variation heating & hot water system	variation ventilation	variation ventilation	variation heating & hot water system
low temperature boiler	electric resistance system	exhaust ventilation system	ventilation system with heat recovery	condensing boiler + solar dhw system + ventilation system with heat recovery
combined with heat generator for space heating (see above)	combined with heat generator for space heating (see above)	= var. 1-0	= var. 1-0	combined with heat generator for space heating (see above) + additional thermal solar system
(see above)	(see above)	= var. 1-0	= var. 1-0	(see above)
(see above)	(see above)	= var. 1-0	= var. 1-0	(see above)
hot water storage	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
central heating room (attic)	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
120 liter	= var. 1-0	= var. 1-0	= var. 1-0	400 liter
1,75 kWh/d	= var. 1-0	= var. 1-0	= var. 1-0	2,6 kWh/d
without hot water circulation	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
completely inside of the thermal envelope, vertical central string	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
60°C	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
-	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
main string / heating room	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
2 m	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
10 mm	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
0,30 W/(m²K)	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
main string / vertical	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
6 m	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
10 mm	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
0,30 W/(m²K)	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
distribution in kitchen and in bathroom / WC	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
10 m	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
-	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
0,40 W/(m²K)	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
none	= var. 1-0	exhaust ventilation system	ventilation system with heat recovery	ventilation system with heat recovery
none	none	DC fan	heat recovery 80%, DC fan	heat recovery 80%, DC fan

Appendix 1d: Country sheets

Applied method

Country
Region

Germany
whole country

Type of requirements /
method used to proof the compliance

Calculation according to the German Energy Saving Ordinance (Energieeinsparverordnung EnEV 2007)
simplified method (EnEV vereinfachtes Verfahren)
calculation building: seasonal balance (according to DIN V 4108-6)
calculation system: table values (according to DIN V 4701-10 Annex C)

Requirements to be complied: maximum values for thermal transmittance and primary energy demand

Requirements in force since

October 2007

Resulting U-values

Variant N°

variant name

U-values

U-value defined for
temperature difference
between room and ...

roof

walls

windows

door

floor above soil

1-0	1-11	1-12	1-13	1-21	1-22	1-31	1-41	1-42	NEW
basis	hg-cond	hg-pellet	hg-hp	dhw-el	dhw-sol	sys-el	vent-exh	vent-rec	sys-cond/sol /rec
0,18	0,2	0,33	0,33	0,18	0,2	-	0,18	0,33	0,33
0,4	0,46	0,5	0,5	0,35	0,48	-	0,35	0,5	0,5
1,5	1,5	1,5	1,5	1,5	1,5	-	1,5	1,5	1,5
2,0	2,0	2,0	2,0	2,0	2,0	-	2,0	2,0	2,0
0,35	0,35	0,5	0,5	0,3	0,35	-	0,35	0,5	0,5
maximum primary energy demand	maximum primary energy demand	maximum heat transfer coefficient	maximum heat transfer coefficient	maximum primary energy demand	maximum primary energy demand	-	maximum primary energy demand	maximum heat transfer coefficient	maximum heat transfer coefficient
						realisation practically not possible (compliance only by inserting U- values < 0,10 W/(m²K))			

[W/(m²K)]

[W/(m²K)]

[W/(m²K)]

[W/(m²K)]

[W/(m²K)]

Restricting limit

Remarks

Mean heat transmission losses (basis for cross country comparison)

Element	Element area (external dimensions)		Simplified heat transfer coefficient									
	[m²]	Correction factor (only for cross-country comparison)	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
roof	82,5	1	14,9	16,5	27,2	27,2	14,9	16,5	-	14,9	27,2	27,2
walls	133,4	1	53,4	61,4	66,7	66,7	46,7	64,0	-	46,7	66,7	66,7
windows	26,5	1	39,8	39,8	39,8	39,8	39,8	39,8	-	39,8	39,8	39,8
door	1,9	1	3,8	3,8	3,8	3,8	3,8	3,8	-	3,8	3,8	3,8
floor above soil	72,3	0,6	15,2	15,2	21,7	21,7	13,0	15,2	-	15,2	21,7	21,7
sum	317		127	137	159	159	118	139	0	120	159	159
Mean heat transmission losses per m² envelope (basis: external dimensions, not considering thermal bridges)			0,40	0,43	0,50	0,50	0,37	0,44	-	0,38	0,50	0,50

[W/(m²K)]

Applied method

Country
Region

Austria

whole country

Type of requirements /
method used to proof the compliance

In Austria the relevant regulation is the net energy demand for heating per m² depending on the proportion of building volume to building surface ($l_v = V/A$). The requirements are regulated in the OIB directive 6 "Energieeinsparung und Wärmeschutz" from April 2007 and are calculated with a reference climate with 3.400 degree days. The calculation method is defined in the Austrian Standard ÖNORM B 8110-6, which is based on the ISO EN 13790.. Main estimations, which were not provided: "heavy construction" (brick or concrete) and air exchange rate 0,4/h with window ventilation. The heating system has no influence on the U-Values. The current requirement (until 31.12.2009): $HWB = 26 * (1 + 2/l_v)$. The data of the model building: $l_v = 1,69m$; $HWB < 56,76 kWh/m^2a$.

Requirements in force since

April 2007

Resulting U-values

Variant N°

variant name

U-values

U-value defined for
temperature difference
between room and ...

roof

walls

windows

door

floor above soil

1-0	1-11	1-12	1-13	1-21	1-22	1-31	1-41	1-42	NEW
basis	hg-cond	hg-pellet	hg-hp	dhw-el	dhw-sol	sys-el	vent-exh	vent-rec	sys-cond/sol/rec

[W/(m²K)]

[W/(m²K)]

[W/(m²K)]

[W/(m²K)]

[W/(m²K)]

Restricting limit

Remarks

Mean heat transmission losses (basis for cross country comparison)

Element	Element area (external dimensions) (only for cross-country comparison)		Simplified heat transfer coefficient									
	[m ²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
roof	82,5	1	16,5	16,5	16,5	16,5	16,5	16,5	16,5	16,5	16,5	16,5
walls	133,4	1	46,7	46,7	46,7	46,7	46,7	46,7	46,7	46,7	46,7	46,7
windows	26,5	1	37,1	37,1	37,1	37,1	37,1	37,1	37,1	37,1	37,1	37,1
door	1,9	1	3,2	3,2	3,2	3,2	3,2	3,2	3,2	3,2	3,2	3,2
floor above soil	72,3	0,6	17,4	17,4	17,4	17,4	17,4	17,4	17,4	17,4	17,4	17,4
sum	317		121	121	121	121	121	121	121	121	121	121
Mean heat transmission losses per m ² envelope (basis: external dimensions, not considering thermal bridges)			0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38

[W/(m²K)]

Applied method

Country	Czech Republic
Region	whole country

Type of requirements /
method used to proof the compliance

Calculation method according to the requirements of the Act no. 406/2000 Coll. on Energy Management, its amendment no. 177/2006 Coll. as amended by no. 406/2006 Coll. and the Code of Practice no. 148/2007 Coll. on Energy Demand of Buildings as amended. A specific technical regulation in this field is the Czech standard ČSN 73 0540 "Thermal Protection of Buildings" (and a set of relevant standards), which the abovementioned statutes are related to and make its requirements binding. Valid requirements for U values are set forth in the second part of the standard i.e. in ČSN 73 0540-2 as of April 2007. Two groups of U values are prescribed: recommended values and required values. Required U-values were used in this table.

April 2007

Requirements in force since

April 2007

Resulting U-values

Variant N°

variant name

U-values

U-value defined for temperature difference between room and ...

roof

walls

windows

door

floor above soil

Restricting limit

Remarks

[illegible]

Mean heat transmission losses (basis for cross country comparison)

	Element area (external dimensions) <small>(only for cross-country comparison)</small>	Correction factor	Simplified heat transfer coefficient									
Element	[m ²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
roof	82,5	1	19,8	19,8	19,8	19,8	19,8	19,8	19,8	19,8	19,8	19,8
walls	133,4	1	50,7	50,7	50,7	50,7	50,7	50,7	50,7	50,7	50,7	50,7
windows	26,5	1	45,1	45,1	45,1	45,1	45,1	45,1	45,1	45,1	45,1	45,1
door	1,9	1	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7
floor above soil	72,3	0,6	19,5	19,5	19,5	19,5	19,5	19,5	19,5	19,5	19,5	19,5
sum	317		142	142	142	142	142	142	142	142	142	142
Mean heat transmission losses per m² envelope (basis: external dimensions, not considering thermal bridges)			0,45	0,45	0,45	0,45	0,45	0,45	0,45	0,45	0,45	0,45

[W/(m²K)]

Applied method

Country
Region

Poland
whole country

Type of requirements /
method used to proof the compliance

Values defined in "Technical conditions to be fulfilled by new and modernised buildings".
There are no differences in required U values for different types of heating, but there are differences between rooms with different internal temperature. Ex. different type of living rooms that computational temperature is over 16 C, for other room (like halls, staircases, cellars) it is between 8 an 16 C.

Requirements in force since

October 2002

Resulting U-values

Variant N°

variant name

U-values

U-value defined for
temperature difference
between room and ...

roof

walls

windows

door

floor above soil

1-0	1-11	1-12	1-13	1-21	1-22	1-31	1-41	1-42	NEW
basis	hg-cond	hg-pellet	hg-hp	dhw-el	dhw-sol	sys-el	vent-exh	vent-rec	sys-cond/sol/rec

[W/(m²K)]

[W/(m²K)]

[W/(m²K)]

[W/(m²K)]

[W/(m²K)]

Restricting limit

Remarks

there is no differences of required U-value in relation to the heating system

there is no differences of required U-value in relation to the heating system

there is no differences of required U-value in relation to the heating system

there is no differences of required U-value in relation to the heating system

there is no differences of required U-value in relation to the heating system

there is no differences of required U-value in relation to the heating system

there is no differences of required U-value in relation to the heating system

there is no differences of required U-value in relation to the heating system

there is no differences of required U-value in relation to the heating system

there is no differences of required U-value in relation to the heating system

Mean heat transmission losses (basis for cross country comparison)

Element	Element area (external dimensions) (only for cross-country comparison)		Simplified heat transfer coefficient									
	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
roof	82,5	1	24,8	24,8	24,8	24,8	24,8	24,8	24,8	24,8	24,8	24,8
walls	133,4	1	40,0	40,0	40,0	40,0	40,0	40,0	40,0	40,0	40,0	40,0
windows	26,5	1	53,0	53,0	53,0	53,0	53,0	53,0	53,0	53,0	53,0	53,0
door	1,9	1	4,9	4,9	4,9	4,9	4,9	4,9	4,9	4,9	4,9	4,9
floor above soil	72,3	0,6	26,0	26,0	26,0	26,0	26,0	26,0	26,0	26,0	26,0	26,0
sum	317		149	149	149	149	149	149	149	149	149	149
Mean heat transmission losses per m² envelope (basis: external dimensions, not considering thermal bridges)			0,47	0,47	0,47	0,47	0,47	0,47	0,47	0,47	0,47	0,47

[W/(m²K)]

Applied method

Country
Region

Sweden
Lund

Type of requirements /
method used to proof the compliance

From the Swedish regulation for building (Regelsamling för byggande - Boverkets byggregler, BBR, 2006)

Requirements for housing
Maximum specific energy consumption 110 kWh/m² floor area (internal) in south Sweden, 130 kWh/m² floor area (internal) in north Sweden. Household electricity is not included in the specific energy consumption.

For one or two family houses with direct-acting electric heating system is the requirement for maximum specific energy consumption 75 kWh/m² floor area (internal) in south Sweden, 95 kWh/m² floor area (internal) in north Sweden. Household electricity is not included in the specific energy consumption.

Maximum U_m for the total building 0,50 W/m²K
Minimum ventilation 0,35 l/s m²

Requirements in force since 2006

Resulting U-values

Variant N°

variant name

U-values

U-value defined for
temperature difference
between room and ...

roof

walls

windows

door

floor above soil

1-0	1-11	1-12	1-13	1-21	1-22	1-31	1-41	1-42	NEW	
basis	hg-cond	hg-pellet	hg-hp	dhw-el	dhw-sol	sys-el	vent-exh	vent-rec	sys-cond/sol/rec	
external air	0,16	0,16	0,16	0,3	0,03	0,3	0,03	0,3	0,3	0,3
external air	0,21	0,21	0,21	0,34	0,04	0,34	0,04	0,34	0,34	0,34
external air	1,2	1,2	1,2	1,5	0,8	1,5	0,8	1,5	1,5	1,5
external air	1,1	1,1	1,1	2,0	0,8	2,0	0,8	2,0	2,0	2,0
soil	0,16	0,16	0,16	0,47	0,01	0,27	0,01	0,47	0,47	0,47

[W/(m²K)]

[W/(m²K)]

[W/(m²K)]

[W/(m²K)]

[W/(m²K)]

Restricting limit

Remarks

Maximum specific energy consumption 110 kWh/m ² floor area			Maximum U _m for the total building 0,50 W/m ² K		Maximum specific energy consumption 110 kWh/m ² floor area	Electric heating system with maximum specific energy consumption requirement 75 kWh/m ² floor area	Maximum U _m for the total building 0,50 W/m ² K	Maximum U _m for the total building 0,50 W/m ² K and maximum specific energy consumption 110 kWh/m ² floor area	Maximum U _m for the total building 0,50 W/m ² K
calculated energy consumption for the building 110 kWh/m ² . With exhaust ventilation system	Same as 1-0	Same as 1-0	calculated energy consumption for the building 78 kWh/m ² . heat pump	Same as 1-31	Solar energy is "free" energy. Calculated energy consumption for the building 107 kWh/m ² . With exhaust ventilation system	calculated energy consumption for the building 76 kWh/m ² . With exhaust ventilation system. This type of house is not realistic – it needs a heat pump for heat recovery	calculated energy consumption for the building 98 kWh/m ² . With exhaust air heat pump	calculated energy consumption for the building 108 kWh/m ² . With balanced ventilation, mechanical supply and exhaust ventilation	

Mean heat transmission losses (basis for cross country comparison)

Element	Element area (external dimensions) (only for cross-country comparison)		Simplified heat transfer coefficient									
	[m ²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
roof	82,5	1	13,2	13,2	13,2	24,8	2,5	24,8	2,5	24,8	24,8	24,8
walls	133,4	1	28,0	28,0	28,0	45,4	5,3	45,4	5,3	45,4	45,4	45,4
windows	26,5	1	31,8	31,8	31,8	39,8	21,2	39,8	21,2	39,8	39,8	39,8
door	1,9	1	2,1	2,1	2,1	3,8	1,5	3,8	1,5	3,8	3,8	3,8
floor above soil	72,3	0,6	6,9	6,9	6,9	20,4	0,4	11,7	0,4	20,4	20,4	20,4
sum	317		82	82	82	134	31	125	31	134	134	134
Mean heat transmission losses per m ² envelope (basis: external dimensions, not considering thermal bridges)			0,26	0,26	0,26	0,42	0,10	0,40	0,10	0,42	0,42	0,42

[W/(m²K)]

Applied method

Country
Region

Denmark
whole country

Type of requirements /
method used to proof the compliance

Monthly calculation according to the SBI direction 213, Calculation of buildings energy demand.
- heating demand is based on prEN ISO 13790:2005, which elaborates on EN 832 and EN ISO 13790.
- heat loss from installations is calculated as defined in prEN 15316 part 2.3 og part 3.2.
- boilers is calculated according to prEN 15316 part 4.1 methode II and part 3.3.
- calculation tool: Be06, version 2,7,5,3

Requirements to be complied: maximum primary energy demand, maximum values for overall thermal transmittance and maximum U-values for constructions.

This new building must have an energy consumption less than 70+2200/A, having a dimensioning transmission loss less than 8 W/m² through the thermal envelope or meet maximum U-values for the constructions.

Requirements in force since

January 2006

Resulting U-values

Variant N°

variant name

U-values

U-value defined for
temperature difference
between room and ...

roof
walls
windows
door
floor above soil

1-0	1-11	1-12	1-13	1-21	1-22	1-31	1-41	1-42	NEW
basis	hg-cond	hg-pellet	hg-hp	dhw-el	dhw-sol	sys-el	vent-exh	vent-rec	sys-cond/sol/rec
external air	-	0,25	0,25	0,25	0,25	0,25	0,15	0,25	0,25
external air	-	0,28	0,28	0,28	0,28	0,28	0,18	0,28	0,28
external air	-	1,51	1,51	1,51	1,51	1,51	1,51	1,51	1,51
external air	-	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5
soil	-	0,3	0,3	0,3	0,2	0,3	0,17	0,3	0,3
-	overall dimensioning transmission loss (8 W/m ² thermal envelope)	overall dimensioning transmission loss (8 W/m ² thermal envelope)	overall dimensioning transmission loss (8 W/m ² thermal envelope)	maximum primary energy demand	overall dimensioning transmission loss (8 W/m ² thermal envelope)	maximum primary energy demand	overall dimensioning transmission loss (8 W/m ² thermal envelope)	overall dimensioning transmission loss (8 W/m ² thermal envelope)	overall dimensioning transmission loss (8 W/m ² thermal envelope)
Non-condensing gas boiler is illegal in Denmark, variation 1-11 is thus used as base case for the other calculations.	Overall dimensioning transmission loss ≤ 8.0 W/m ² K, incl. thermal bridges	Estimated efficiency of pellet burner is 80 % for full and part load.			Fulfills the requirement for Low Energy class 2, which is approx. 25 % better than minimum Building Regulation requirement.		Exhaust ventilation air flow of 50 l/s (2 toilets and 1 kitchen) and infiltration of 0,13 l/s m ² .	Heat recovery efficiency 65%. Same ventilation rate as variant 1-41	Fulfills the requirement for Low Energy class 2, which is approx. 25 % better than minimum Building Regulation requirement.

[W/(m²K)]
[W/(m²K)]
[W/(m²K)]
[W/(m²K)]
[W/(m²K)]

Restricting limit

Remarks

Mean heat transmission losses (basis for cross country comparison)

Element	Element area (external dimensions) (only for cross-country comparison)		Simplified heat transfer coefficient									
	[m ²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
roof	82,5	1	-	20,6	20,6	20,6	20,6	20,6	12,4	20,6	20,6	20,6
walls	133,4	1	-	37,4	37,4	37,4	37,4	37,4	24,0	37,4	37,4	37,4
windows	26,5	1	-	40,0	40,0	40,0	40,0	40,0	40,0	40,0	40,0	40,0
door	1,9	1	-	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9
floor above soil	72,3	0,6	-	13,0	13,0	13,0	8,7	13,0	7,4	13,0	13,0	13,0
sum	317		0	114	114	114	110	114	87	114	114	114
Mean heat transmission losses per m ² envelope (basis: external dimensions, not considering thermal bridges)			-	0,36	0,36	0,36	0,35	0,36	0,27	0,36	0,36	0,36

Applied method

Country
Region

UK
England & Wales

Type of requirements /
method used to proof the compliance

SAP 2005 (www.bre.co.uk/sap2005)
Seasonal energy balance

Requirements to be complied with: maximum CO2 emissions, maximum U-values, minimum heating efficiency

Requirements in force since

2005

Resulting U-values

Variant N°

variant name

U-values

U-value defined for
temperature difference
between room and ...

roof

walls

windows

door

floor above soil

1-0	1-11	1-12	1-13	1-21	1-22	1-31	1-41	1-42	NEW
basis	hg-cond	hg-pellet	hg-hp	dhw-el	dhw-sol	sys-el	vent-exh	vent-rec	sys-cond/sol/rec

external air	-	0,16	0,25	0,25	0,16	0,25	0,16	0,2	0,25	0,25
external air	-	0,33	0,35	0,35	0,22	0,35	0,21	0,35	0,35	0,35
external air	-	1,8	2,2	2,2	1,5	2,2	1,5	1,8	2,2	2,2
external air	-	2,0	2,2	2,2	0,8	2,2	2,0	2,0	2,2	2,2
external air	-	0,22	0,25	0,25	0,2	0,25	0,2	0,23	0,25	0,25

[W/(m²K)]

[W/(m²K)]

[W/(m²K)]

[W/(m²K)]

[W/(m²K)]

Restricting limit

	maximum CO2 emissions	maximum U-values of elements	maximum U-values of elements	maximum CO2 emissions	maximum U-values of elements (although only small margin left on CO2 emissions)	maximum CO2 emissions	maximum CO2 emissions	maximum U-values of elements	maximum U-values of elements
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Remarks

not possible - minimum boiler efficiency is 86% (condensing)				condensing boiler; improved thermal bridging	condensing boiler	improved thermal bridging	condensing boiler	condensing boiler	condensing boiler
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Mean heat transmission losses (basis for cross country comparison)

Element	Element area (external dimensions)		Simplified heat transfer coefficient									
	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
roof	82,5	1	-	13,2	20,6	20,6	13,2	20,6	13,2	16,5	20,6	20,6
walls	133,4	1	-	44,0	46,7	46,7	29,3	46,7	28,0	46,7	46,7	46,7
windows	26,5	1	-	47,7	58,3	58,3	39,8	58,3	39,8	47,7	58,3	58,3
door	1,9	1	-	3,8	4,2	4,2	1,5	4,2	3,8	3,8	4,2	4,2
floor above soil	72,3	1	-	15,9	18,1	18,1	14,5	18,1	14,5	16,6	18,1	18,1
sum	317		0	125	148	148	98	148	99	131	148	148
Mean heat transmission losses per m² envelope (basis: external dimensions, not considering thermal bridges)			-	0,39	0,47	0,47	0,31	0,47	0,31	0,41	0,47	0,47

[W/(m²K)]

Applied method

Country	The Netherlands
Region	whole country
Type of requirements / method used to proof the compliance	<p>Energy use calculations for the heating season (October 1 - April 30) according to (for building as well as system):</p> <ul style="list-style-type: none"> * Dutch Standard NEN 5128: Energy performance of residential functions and residential buildings - Determination method (NNI, March 2004). * Dutch Guideline NPR 5129: Energy performance of residential functions and residential buildings - Calculation program (EPW) with handbook (NNI, April 2005). * EPW for Windows Version 2.02 (NNI, 2006) <p>Requirements to be met:</p> <ul style="list-style-type: none"> * EPC <= 0,8 (EPC = Energy Performance Coefficient, based on primary energy demand), and * Minimum Rc values (heat resistance) for thermal envelope
Requirements in force since	2006 (EPC <=0,8), 1992 (Rc >= 2,5 W/(m²K))

Resulting U-values

Variant N°		1-0	1-11	1-12	1-13	1-21	1-22	1-31	1-41	1-42	NEW	
variant name		basis	hg-cond	hg-pellet	hg-hp	dhw-el	dhw-sol	sys-el	vent-exh	vent-rec	sys-cond/sol/rec	
U-values	U-value defined for temperature difference between room and ...											
roof	external air	-	-	-	0,24	-	-	-	-	-	0,24	[W/(m²K)]
walls	external air	-	-	-	0,24	-	-	-	-	-	0,27	[W/(m²K)]
windows	external air	-	-	-	1,3	-	-	-	-	-	1,8	[W/(m²K)]
door	external air	-	-	-	2,0	-	-	-	-	-	2,0	[W/(m²K)]
floor above soil	soil	-	-	-	0,23	-	-	-	-	-	0,23	[W/(m²K)]
Restricting limit		-	-	-	EPC<=0,80	-	-	-	-	-	EPC<=0,80	
Remarks		Not possible to meet EPC<=0,8. The effect of low performance of heating and ventilation system can not be compensated by improved U-values.	Not possible to meet EPC<=0,8. The effect of low performance of heating and ventilation system can not be compensated by improved U-values.	Wood pellet boiler is no option in Dutch calculation software (except for complicated procedure using 'declaration of quality'). Wood pellet boiler not used as primary heat generator in new		Not possible to meet EPC<=0,8. The effect of low performance of heating and ventilation system can not be compensated by improved U-values.	Not possible to meet EPC<=0,8. The effect of low performance of heating and ventilation system can not be compensated by improved U-values.	Not possible to meet EPC<=0,8. The effect of low performance of heating and ventilation system can not be compensated by improved U-values.	Not possible to meet EPC<=0,8. The effect of low performance of heating and ventilation system can not be compensated by improved U-values.	Not possible to meet EPC<=0,8. The effect of low performance of heating and ventilation system can not be compensated by improved U-values.	condensing boiler (97,5%) radiators mech. Ventilation + heat recovery (80%) solar collector (2,7 m2) default pipe lengths	

Mean heat transmission losses (basis for cross country comparison)

Element	Element area (external dimensions)		Simplified heat transfer coefficient										
	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	
roof	82,5	1	-	-	-	19,8	-	-	-	-	-	19,8	
walls	133,4	1	-	-	-	32,0	-	-	-	-	-	36,0	
windows	26,5	1	-	-	-	34,5	-	-	-	-	-	47,7	
door	1,9	1	-	-	-	3,8	-	-	-	-	-	3,8	
floor above soil	72,3	0,6	-	-	-	10,0	-	-	-	-	-	10,0	
sum	317		0	0	0	100	0	0	0	0	0	117	
Mean heat transmission losses per m² envelope (basis: external dimensions, not considering thermal bridges)			-	-	-	0,32	-	-	-	-	-	0,37	[W/(m²K)]

Applied method

Country
Region

Belgium

Flanders

Type of requirements /
method used to proof the compliance

Method described in the decree of the 5th of march 2005. Three requirements are imposed : one limits the annual characteristic primary energy use, a second one limits the average thermal transmittance, and a third one gives the maximal values of the thermal transmittance.

Requirements in force since

2005

Resulting U-values

Variant N°

variant name

U-values

U-value defined for
temperature difference
between room and ...

roof

walls

windows

door

floor above soil

1-0	1-11	1-12	1-13	1-21	1-22	1-31	1-41	1-42	NEW
basis	hg-cond	hg-pellet	hg-hp	dhw-el	dhw-sol	sys-el	vent-exh	vent-rec	sys-cond/sol/rec

[W/(m²K)]

[W/(m²K)]

[W/(m²K)]

[W/(m²K)]

[W/(m²K)]

Restricting limit

Remarks

Primary energy consumption	Primary energy consumption	Primary energy consumption	Average thermal transmittance	Primary energy consumption	Primary energy consumption	Primary energy consumption	Primary energy consumption	Primary energy consumption	Average thermal transmittance
in addition: exhaust air ventilation system (mandatory)	in addition: exhaust air ventilation system (mandatory)	in addition: exhaust air ventilation system (mandatory)	in addition: exhaust air ventilation system (mandatory)	in addition: exhaust air ventilation system (mandatory)	in addition: exhaust air ventilation system (mandatory)	in addition: exhaust air ventilation system (mandatory)	It is not possible to use this system and fulfill requirements, even with a zero average thermal transmittance.	This variant is the same as variant 1-0	

Mean heat transmission losses (basis for cross country comparison)

Element	Element area (external dimensions) (only for cross-country comparison)		Simplified heat transfer coefficient									
	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
roof	82,5	1	15,7	33,0	7,4	33,0	9,1	25,6	-	15,7	17,3	38,0
walls	133,4	1	25,3	52,0	12,0	62,7	14,7	41,4	-	25,3	28,0	60,0
windows	26,5	1	46,6	46,6	46,6	46,6	46,6	46,6	-	46,6	46,6	46,6
door	1,9	1	5,5	5,5	5,5	5,5	5,5	5,5	-	5,5	5,5	5,5
floor above soil	72,3	1	25,3	25,3	25,3	28,9	25,3	25,3	-	25,3	25,3	25,3
sum	317		118	162	97	177	101	144	0	118	123	175
Mean heat transmission losses per m² envelope (basis: external dimensions, not considering thermal bridges)			0,37	0,51	0,31	0,56	0,32	0,46	-	0,37	0,39	0,55

[W/(m²K)]

Applied method

Country	Luxembourg
Region	whole country

Type of requirements / method used to proof the compliance	<p>The calculation has been done according to the Luxembourg "Règlement grand-ducal" (short: RGD) from 30.11.2007 (LuxEeB).</p> <p>The RDG gives minimum requirements for U-Values, air-tightness, thermal bridges, summer requirements, insulation of pipes for heat transfer / hot water transfer and specific fan power for ventilation. Additionally there are main requirements for the heating and primary energy consumption.</p>
Requirements in force since	<p>2008</p>

Resulting U-values

Variant N°		1-0	1-11	1-12	1-13	1-21	1-22	1-31	1-41	1-42	NEW	
variant name		basis	hg-cond	hg-pellet	hg-hp	dhw-el	dhw-sol	sys-el	vent-exh	vent-rec	sys-cond/sol/rec	
U-values		U-value defined for temperature difference between room and ...										
roof	external air	0,2	0,21	0,21	0,21	0,15	0,21	-	0,21	0,25	0,25	[W/(m²K)]
walls	external air	0,24	0,25	0,25	0,25	0,19	0,25	-	0,26	0,32	0,32	[W/(m²K)]
windows	external air	1,35	1,35	1,35	1,35	1,2	1,35	-	1,5	1,5	1,5	[W/(m²K)]
door	external air	1,5	1,5	1,5	1,5	1,5	1,5	-	1,5	2,0	2,0	[W/(m²K)]
floor above soil	external air	0,3	0,3	0,3	0,3	0,25	0,3	-	0,3	0,35	0,4	[W/(m²K)]
Restricting limit		maximum primary energy demand	maximum heat energy demand	maximum heat energy demand	maximum heat energy demand	maximum primary energy demand	maximum heat energy demand	maximum primary energy demand	maximum primary energy demand	maximum heat transfer coefficient		
Remarks								realisation not possible, only with U-Values < 0,02				

Mean heat transmission losses (basis for cross country comparison)

Element	Element area (external dimensions)	Correction factor	Simplified heat transfer coefficient									
	(only for cross-country comparison)											
	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
roof	82,5	1	16,5	17,3	17,3	17,3	12,4	17,3	-	17,3	20,6	20,6
walls	133,4	1	32,0	33,4	33,4	33,4	25,3	33,4	-	34,7	42,7	42,7
windows	26,5	1	35,8	35,8	35,8	35,8	31,8	35,8	-	39,8	39,8	39,8
door	1,9	1	2,9	2,9	2,9	2,9	2,9	2,9	-	2,9	3,8	3,8
floor above soil	72,3	1	21,7	21,7	21,7	21,7	18,1	21,7	-	21,7	25,3	28,9
sum	317		109	111	111	111	90	111	0	116	132	136
Mean heat transmission losses per m² envelope (basis: external dimensions, not considering thermal bridqes)			0,34	0,35	0,35	0,35	0,29	0,35	-	0,37	0,42	0,43

Applied method

Country
Region

France
Alsace (H1b)

Type of requirements /
method used to proof the compliance

The used method is based on several steps:1) use the "reference" U values of each building fabric component to calculate the building overall Uvalue Ubat 2) make sure the result is lower than 1,2 x the "reference" Ubat 3) calculate the project consumption (C in kWh/m2 primary energy) and the reference consumption Cref 4) Check compliance in having C < Cref and C < Cepmax which is an absolute figure depending only on the energy and the location 5) depending on the result, iterate by modifying some Uvalues to comply with the "lowest" effort.

Requirements in force since

September 2006

Resulting U-values

Variant N°

variant name

U-values

U-value defined for
temperature difference
between room and ...

roof

walls

windows

door

floor above soil

Restricting limit

Remarks

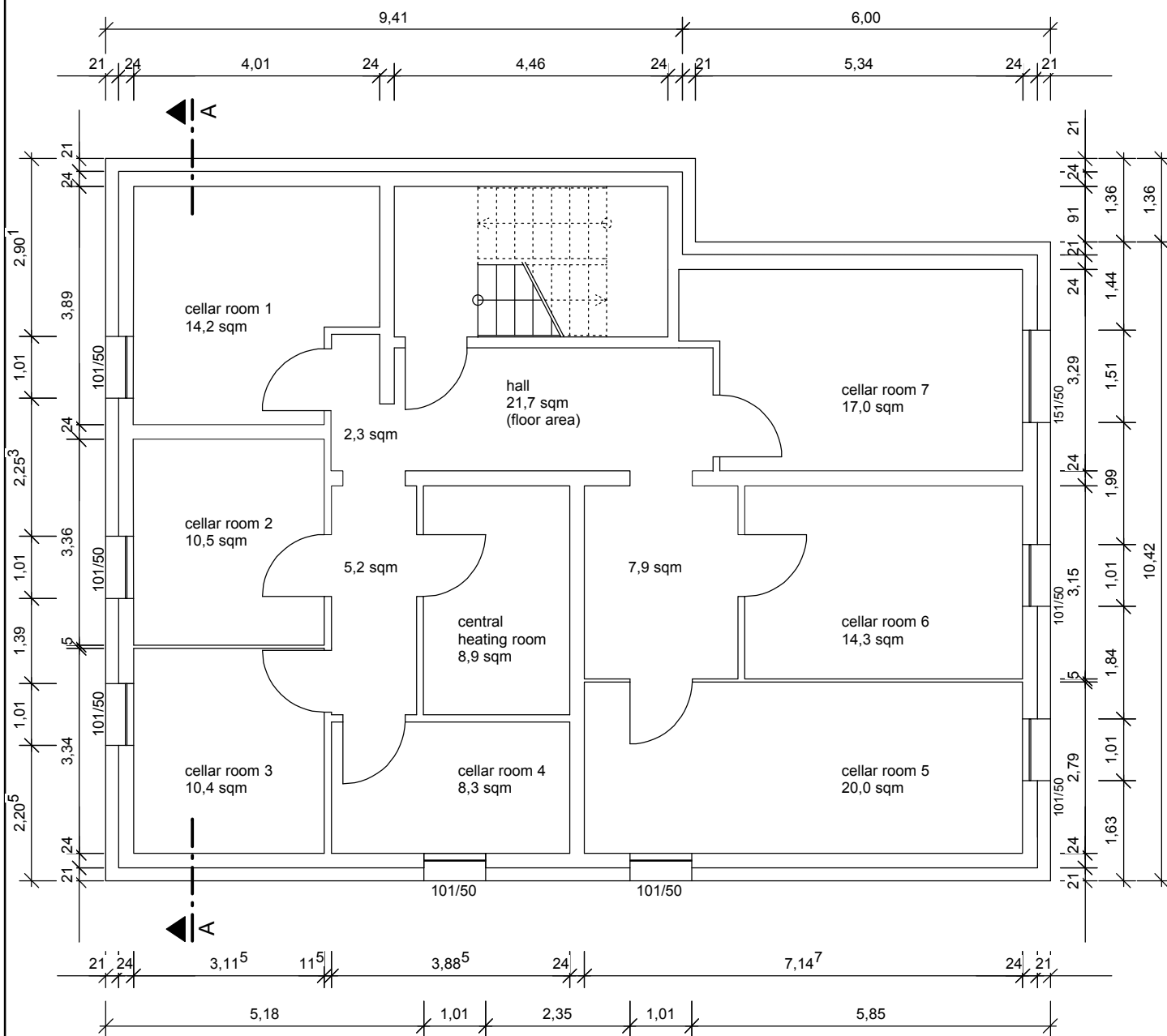
1-0	1-11	1-12	1-13	1-21	1-22	1-31	1-41	1-42	NEW		
basis	hg-cond	hg-pellet	hg-hp	dhw-el	dhw-sol	sys-el	vent-exh	vent-rec	sys-cond/sol/rec		
0,2	0,3	0,2	0,3	0,2	0,2	0,2	0,2	0,2	0,3		[W/(m²K)]
0,36	0,45	0,36	0,45	0,2	0,36	0,36	0,36	0,36	0,45		[W/(m²K)]
1,8	1,8	1,8	2,1	1,8	1,8	1,8	1,8	1,8	2,1		[W/(m²K)]
1,5	1,5	1,5	1,5	1,3	1,5	1,5	1,5	1,5	1,5		[W/(m²K)]
0,27	0,3	0,27	0,3	0,2	0,27	0,27	0,27	0,27	0,3		[W/(m²K)]
Cref	Cref	Cref	Ubat ref	Cep max	Cref	Cref	Cref	Cref	Ubat ref		
				with special treatment of thermal bridges in the case of interior insulation							

Mean heat transmission losses (basis for cross country comparison)

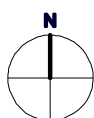
Element area (external dimensions)		Correction factor	Simplified heat transfer coefficient										
(only for cross-country comparison)													
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	
roof	82,5	1	16,5	24,8	16,5	24,8	16,5	16,5	16,5	16,5	16,5	24,8	
walls	133,4	1	48,0	60,0	48,0	60,0	26,7	48,0	48,0	48,0	48,0	60,0	
windows	26,5	1	47,7	47,7	47,7	55,7	47,7	47,7	47,7	47,7	47,7	55,7	
door	1,9	1	2,9	2,9	2,9	2,9	2,5	2,9	2,9	2,9	2,9	2,9	
floor above soil	72,3	1	19,5	21,7	19,5	21,7	14,5	19,5	19,5	19,5	19,5	21,7	
sum	317		135	157	135	165	108	135	135	135	135	165	
Mean heat transmission losses per m² envelope (basis: external dimensions, not considering thermal bridges)			0,43	0,50	0,43	0,52	0,34	0,43	0,43	0,43	0,43	0,52	[W/(m²K)]

Appendix 2: Definition of Model Building 2 – multi-family house

Appendix 2a: Plans



IWU 2008

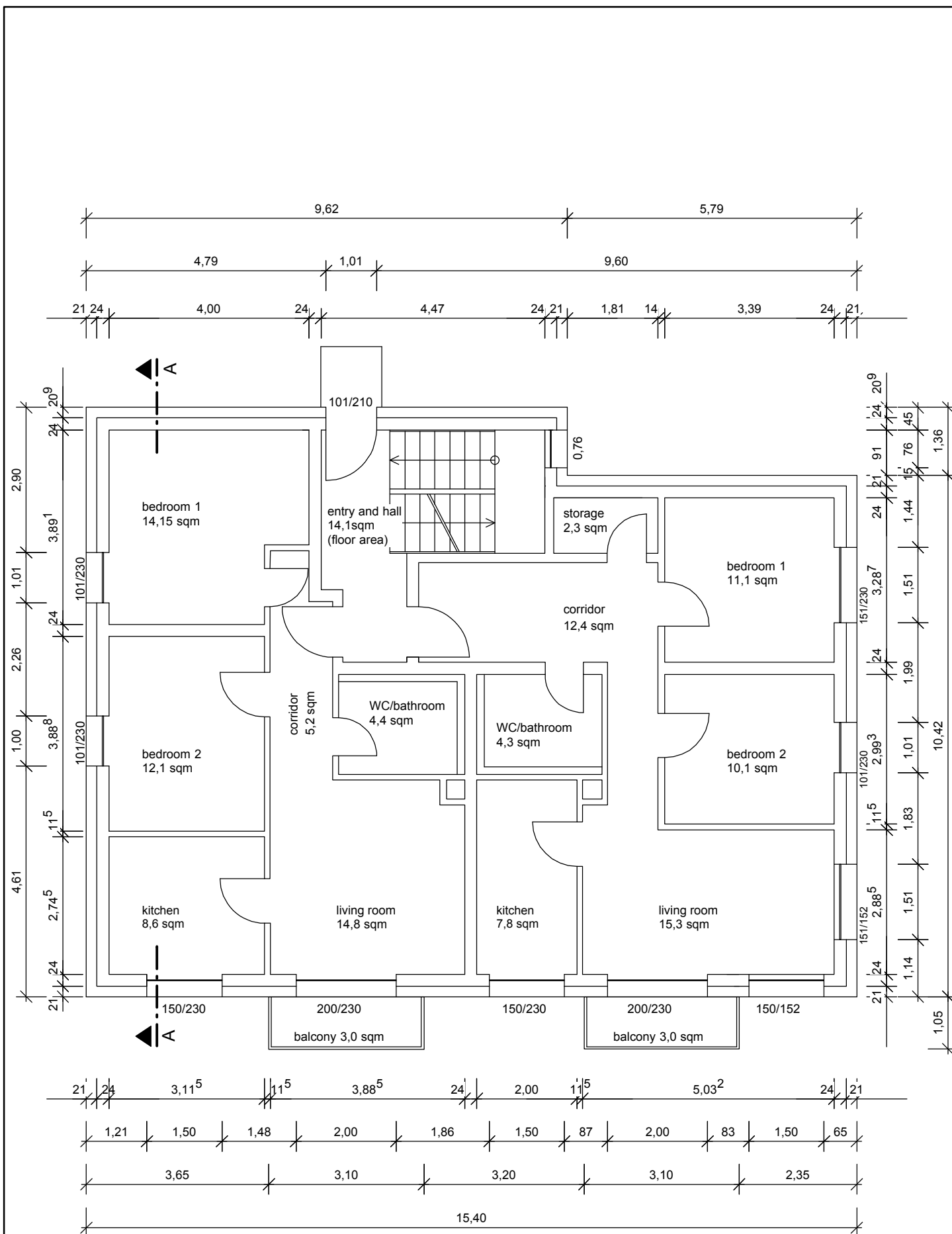


Building APARTMENT HOUSE

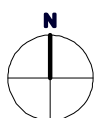
Floor Plan **Basement Floor**

Scale 1:100

Date Jan 2008



IWU 2008

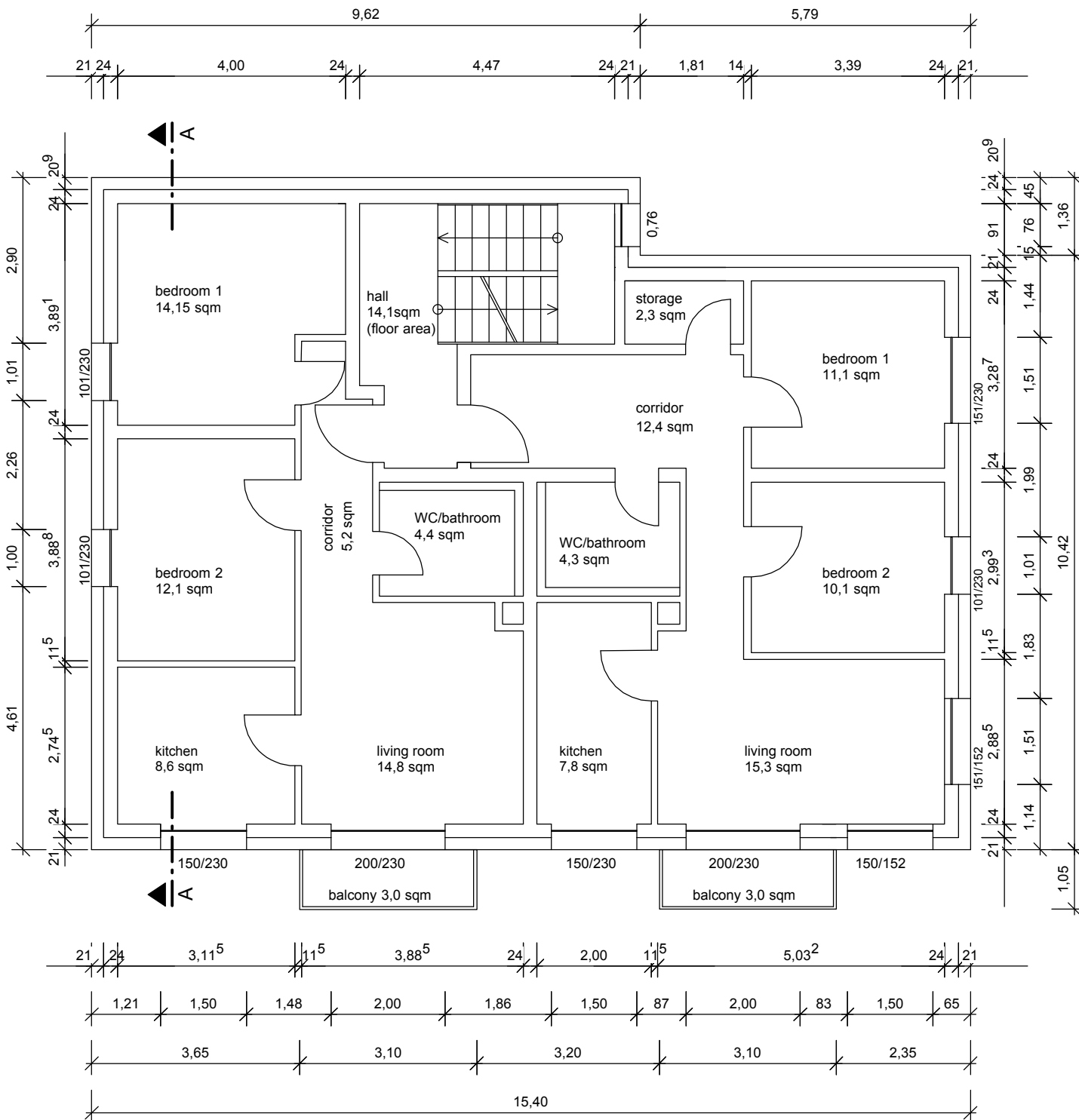


Building APARTMENT HOUSE

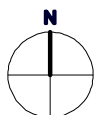
Floor Plan Ground Floor

Scale 1:100

Date Jan 2008



IWU 2008

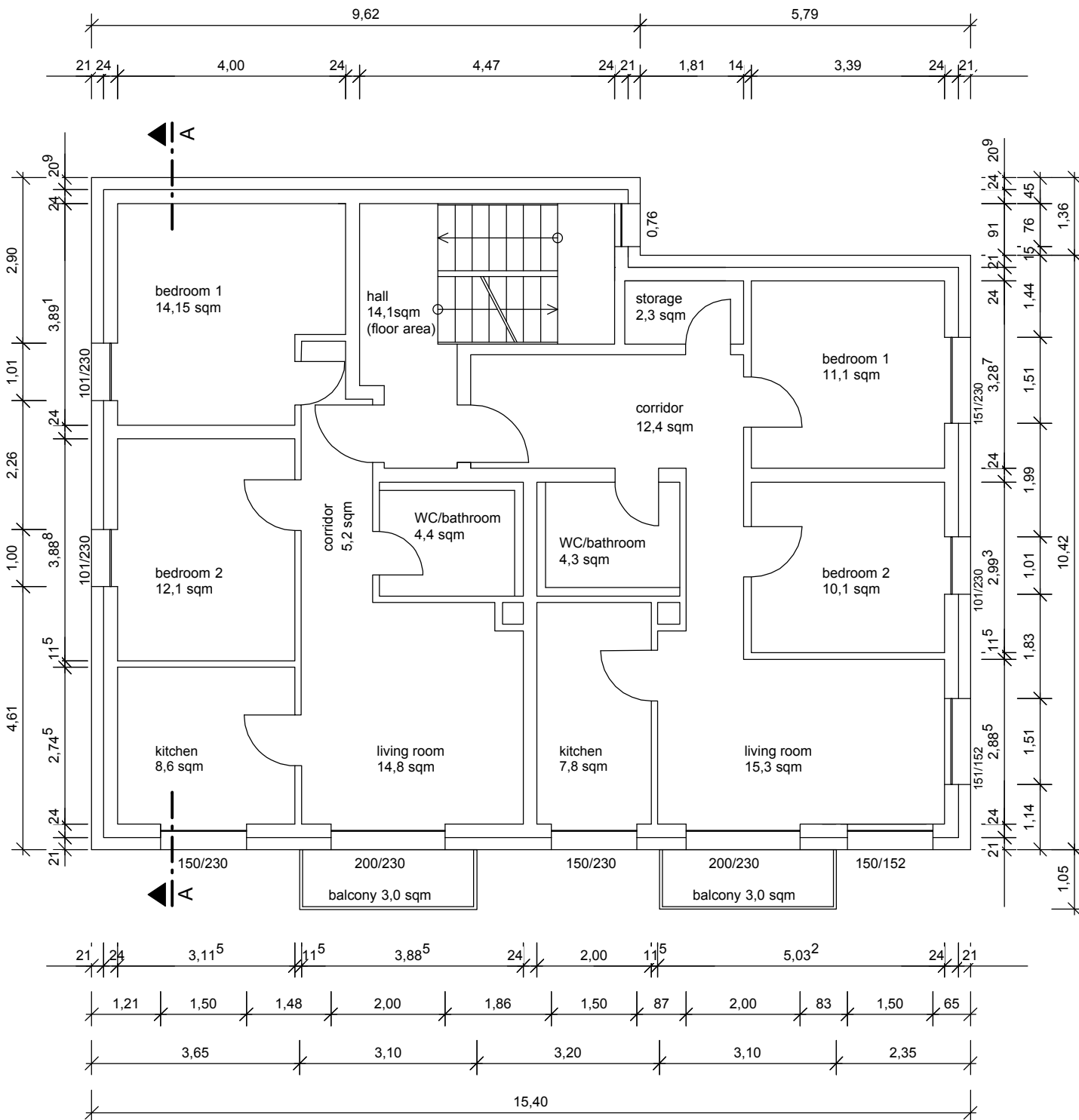


Building APARTMENT HOUSE

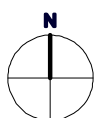
Floor Plan First Floor

Scale 1:100

Date Jan 2008



IWU 2008

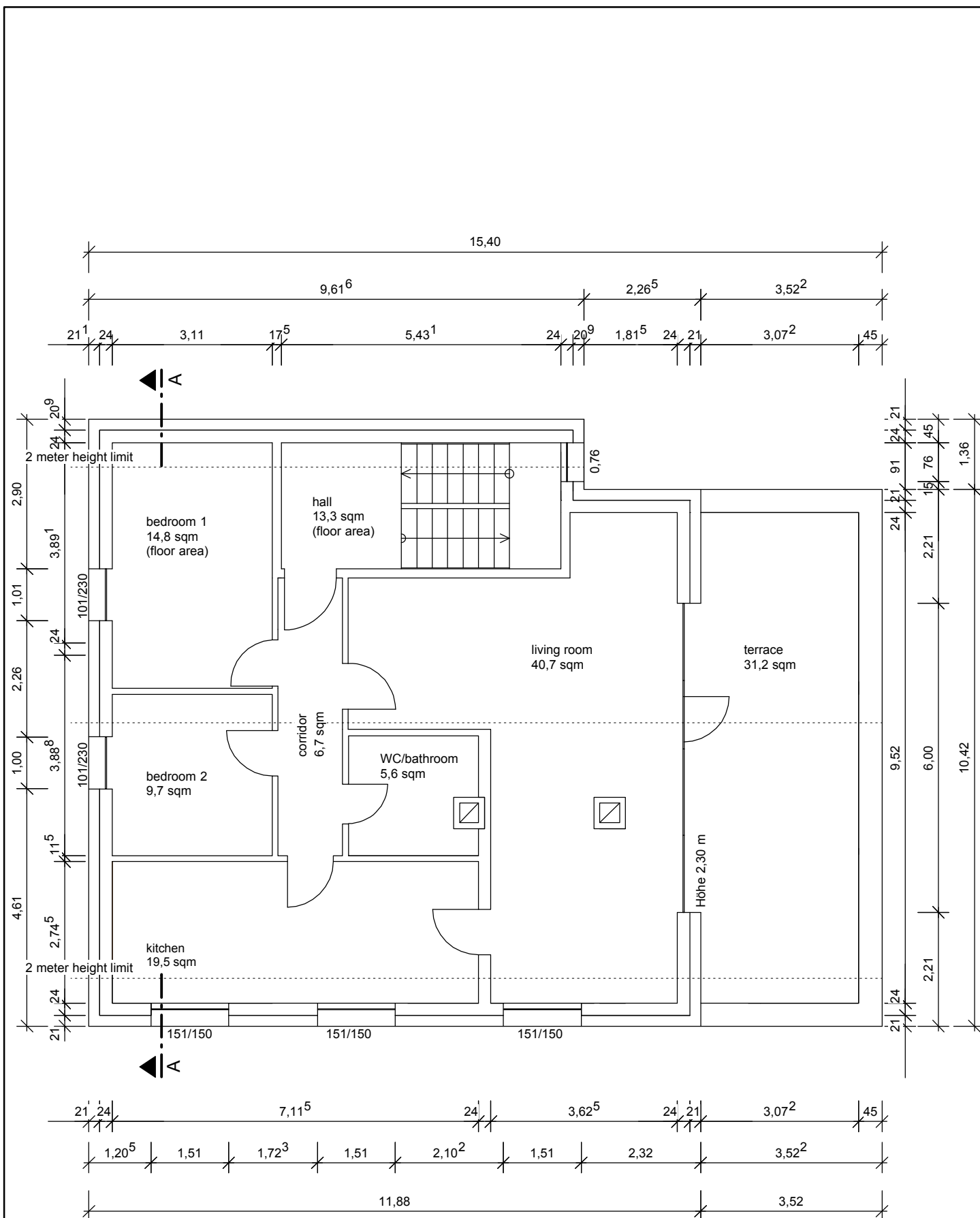


Building APARTMENT HOUSE

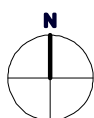
Floor Plan Second Floor

Scale 1:100

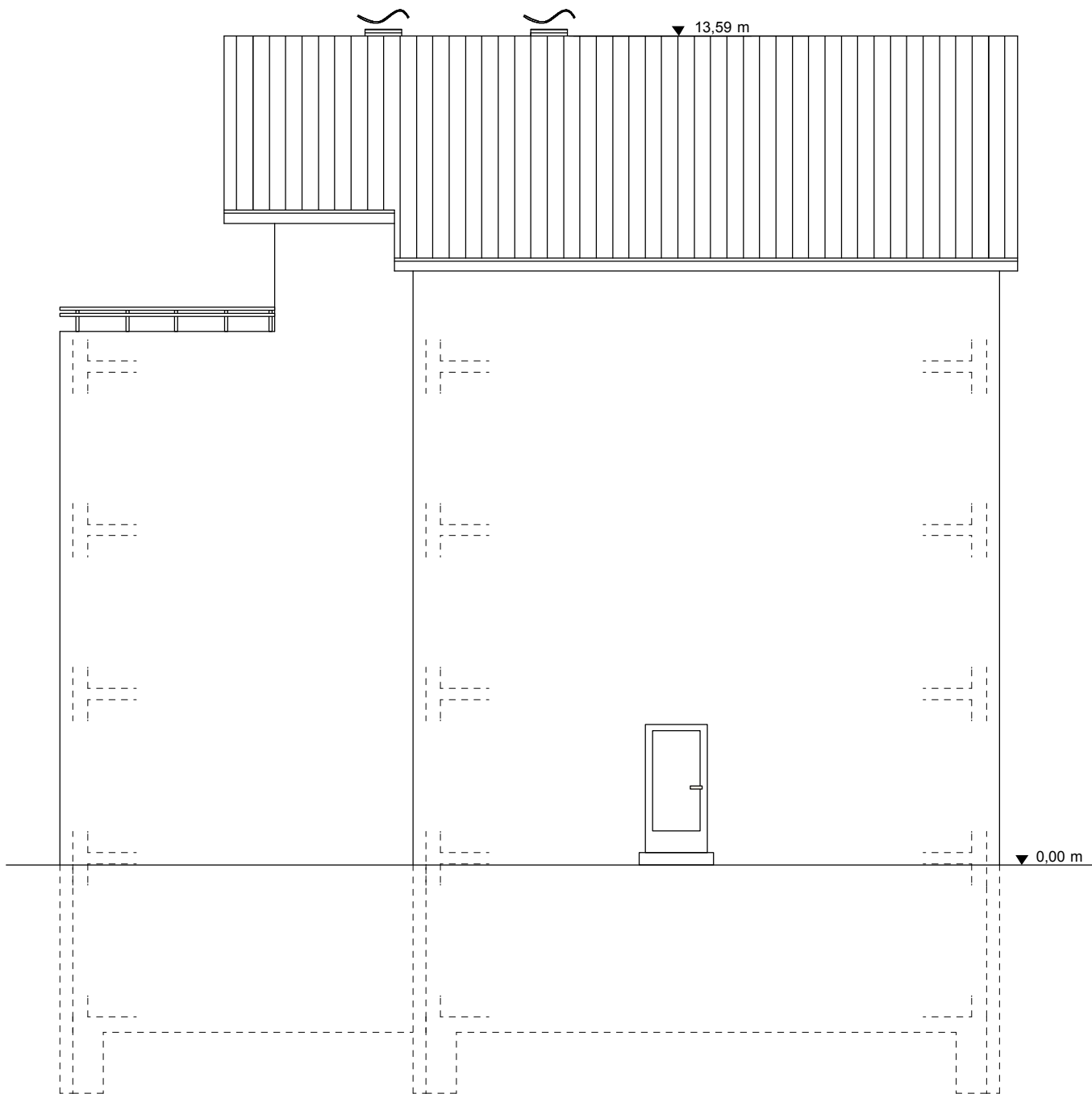
Date Jan 2008



IWU 2008



Building	APARTMENT HOUSE
Floor Plan	Attic Floor
Scale	1:100
Date	Jan 2008



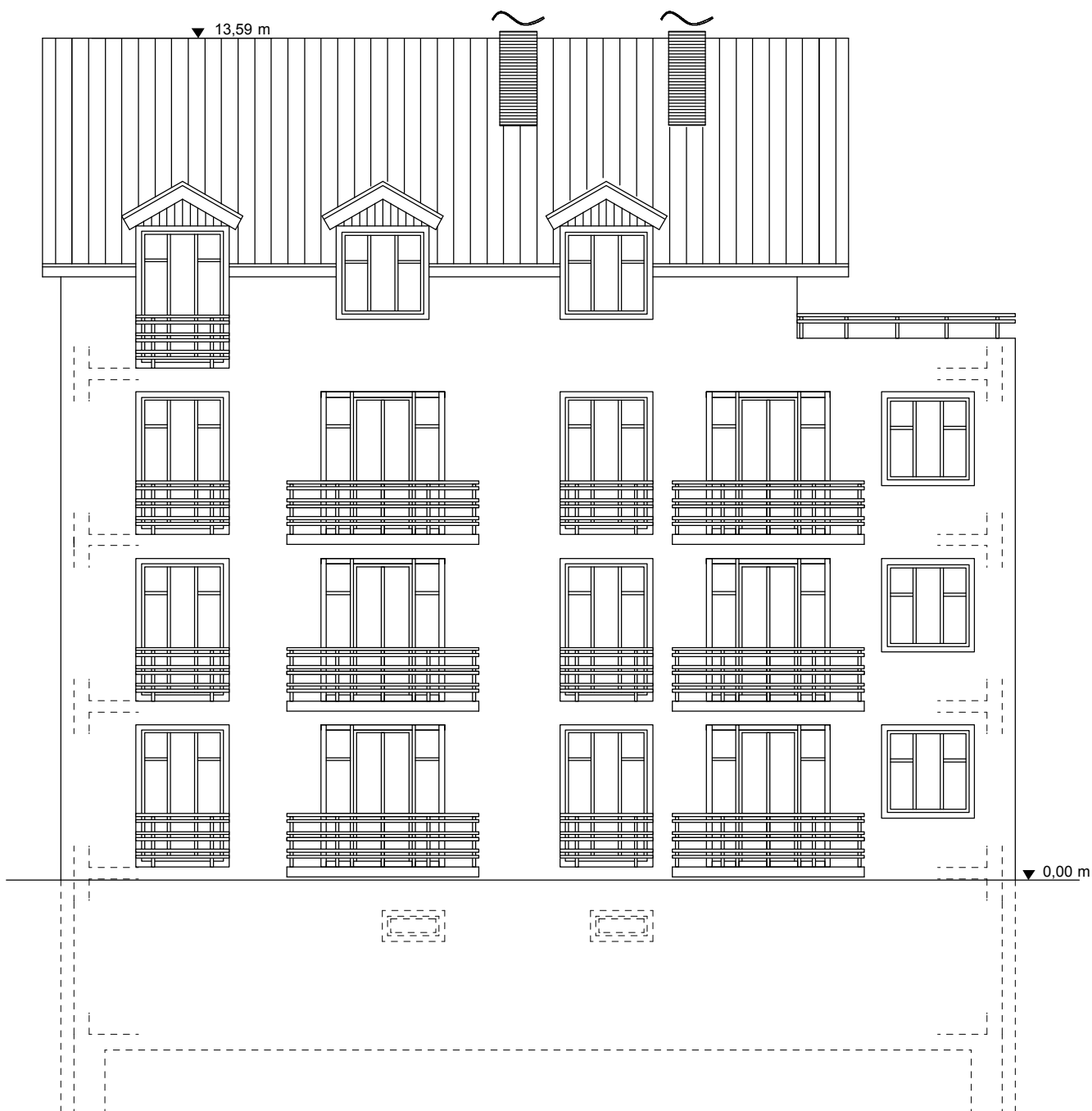
IWU 2008

Building	APARTMENT HOUSE
Plan	Elevation North
Scale	1:100
Date	Jan 2008



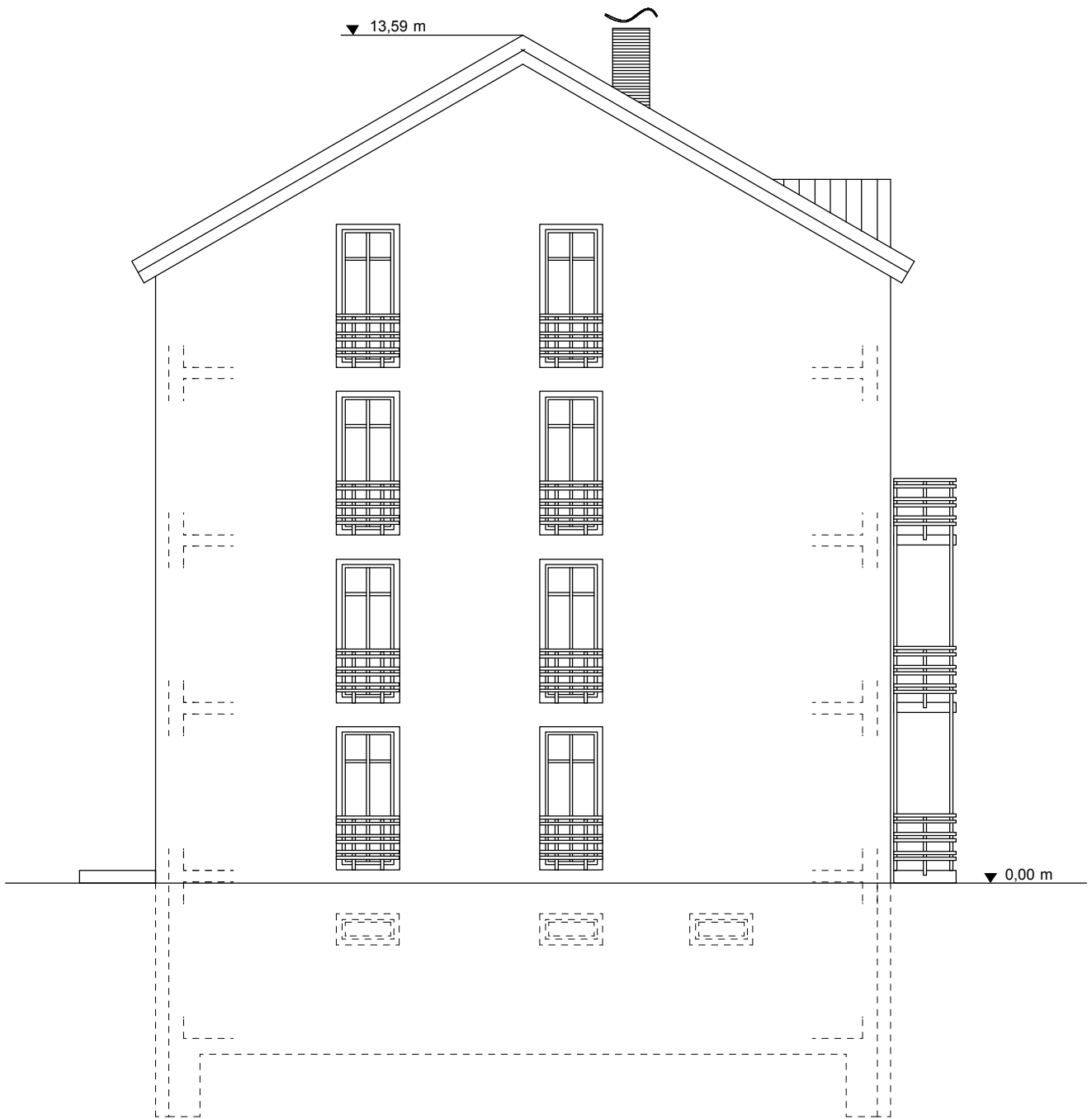
IWU 2008

Building	APARTMENT HOUSE
Plan	Elevation East
Scale	1:100
Date	Jan 2008



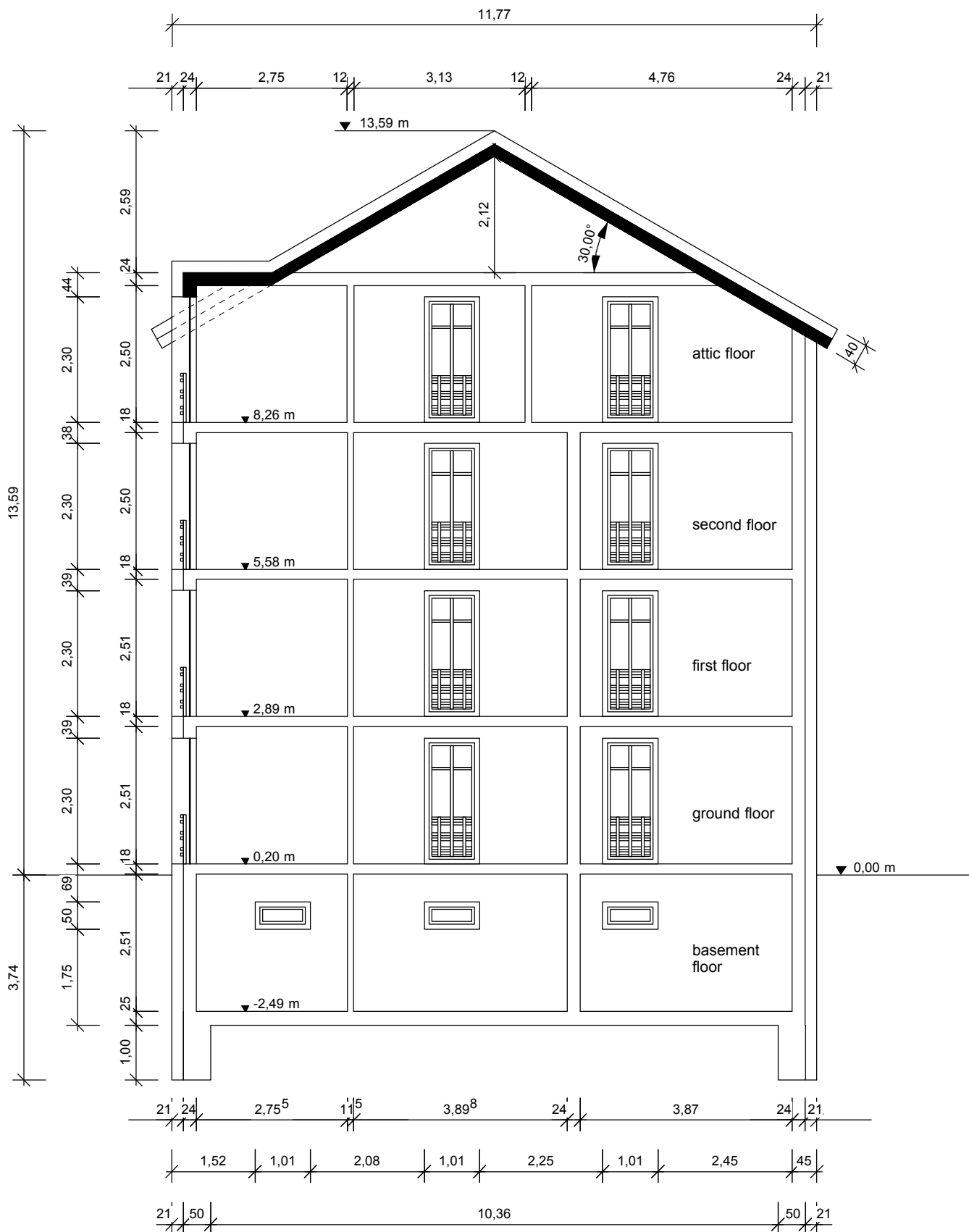
IWU 2008

Building	APARTMENT HOUSE
Plan	Elevation South
Scale	1:100
Date	Jan 2008



IWU 2008

Building	APARTMENT HOUSE
Floor Plan	Elevation West
Scale	1:100
Date	Jan 2008



IWU 2008

Building	APARTMENT HOUSE
Plan	Section A - A
Scale	1:100
Date	Jan 2008

Appendix 2b: Detailed envelope area calculation (external dimensions)

	name area element (free)	further specification / location	dedicated envelope area type	dedicated orientation for windows	reductio n area: insert "R"	width [m]	length [m]	height [m]	number (if <> 1)	addition al area [m²]	gross surface area [m²]	net surface area [m²]	specific loss [W/K]
1.	cellar ceiling		floor to cellar			10,42	15,40			13,083	173,6	158,2	0,0
2.	staircase floor basement		floor to soil		R	3,10	4,94					15,3	0,0
3.	staircase wall to basement West		wall to cellar				3,10	2,76				8,6	0,0
4.	staircase wall to basement East		wall to cellar				1,74	2,76				4,8	0,0
5.	staircase wall to basement South		wall to cellar				4,90	2,76			13,5	11,5	0,0
6.	staircase door to basement		door to cellar		R		1,01	2,00				2,0	0,0
7.	staircase wall to soil North		wall to soil				5,15	2,76				14,2	0,0
8.	staircase wall to soil East		wall to soil				1,36	2,76				3,8	0,0
9.	wall North ground floor		wall				15,40	2,87			44,2	42,1	0,0
10.	entrance door North		door		R		1,01	2,10				2,1	0,0
11.	wall North first + second floor		wall				15,40	2,69	2			82,9	0,0
12.	wall North attic floor		wall				11,88	1,95		1,816		25,0	0,0
13.	wall East ground floor		wall				11,78	2,87			33,8	23,7	0,0
14.	window East staircase ground floor		window	E	R		0,76	2,69				2,0	0,0
15.	window East ground floor 1		window	E	R		1,51	2,30				3,5	0,0
16.	window East ground floor 2		window	E	R		1,01	2,30				2,3	0,0
17.	window East ground floor 3		window	E	R		1,51	1,52				2,3	0,0
18.	wall East first + second floor		wall				11,78	2,69	2		63,4	43,1	0,0
19.	window East staircase first + second floor		window	E	R		0,76	2,69	2			4,1	0,0
20.	window East first + second floor 1		window	E	R		1,51	2,30	2			6,9	0,0
21.	window East first + second floor 2		window	E	R		1,01	2,30	2			4,6	0,0
22.	window East first + second floor 3		window	E	R		1,51	1,52	2			4,6	0,0
23.	wall East attic floor		wall				11,78	1,95		19,908	42,9	27,6	0,0
24.	window East staircase attic floor		window	E	R		0,76	2,00				1,5	0,0
25.	windows East attic floor		window	E	R		6,00	2,30				13,8	0,0
26.	wall South ground floor		wall				15,40	2,87			44,2	25,8	0,0
27.	window South ground floor 1		window	S	R		1,50	1,52				2,3	0,0
28.	window South ground floor 2		window	S	R		2,00	2,30	2			9,2	0,0
29.	window South ground floor 3		window	S	R		1,50	2,30	2			6,9	0,0
30.	wall South first + second floor		wall				15,40	2,69	2		82,9	46,1	0,0
31.	window South first + second floor 1		window	S	R		1,50	1,52	2			4,6	0,0
32.	window South first + second floor 2		window	S	R		2,00	2,30	4			18,4	0,0
33.	window South first + second floor 3		window	S	R		1,50	2,30	4			13,8	0,0
34.	wall South attic floor		wall				11,88	1,95		1,575	24,7	16,8	0,0
35.	window South attic floor 1		window	S	R		1,50	2,30				3,5	0,0
36.	window South attic floor 2		window	S	R		1,50	1,50	2			4,5	0,0
37.	gable dormers		dormer wall				1,50	0,50	3			2,3	0,0
38.	side wall dormers		dormer wall				1,10	0,325	6			2,1	0,0
39.	wall West ground floor		wall				11,78	2,87			33,8	29,2	0,0
40.	window West ground floor		window	W	R		1,01	2,30	2			4,6	0,0
41.	wall West first + second floor		wall				11,78	2,69	2		63,4	54,1	0,0
42.	window West first + second floor		window	W	R		1,01	2,30	4			9,3	0,0
43.	wall West attic floor		wall				11,78	3,64			42,9	38,2	0,0
44.	window West attic floor		window	W	R		1,01	2,30	2			4,6	0,0
45.	ceiling second floor (balcony floor attic)		flat roof			3,52	10,42					36,7	0,0
46.	tilted roof North		tilted roof			6,801	11,88			-3,565		77,2	0,0
47.	tilted roof South		tilted roof			6,801	11,88			-7,65		73,1	0,0
48.	tilted roof dormers		dormer roof			1,732	1,45		3			7,5	0,0
49.												0,0	0,0
50.												0,0	0,0
Gesamt thermische Hülle:											1001,3	0,0	

Appendix 2c: Definition of the supply system types

Explanation of table colours:

green

= basic definition of the system

blue

= to be used only if necessary; if not compatible to the national definitions or values the most similar ones were to be used

Variants basis, hg-bnc, hg-pellet, hg-hp, dhw-el, dhw-sol

variant

variant N°
variant name
variant type

description

building

thermal envelope

envelope surface area
thermal bridges

air-tightness

solar gains

total solar energy transmittance (for radiation perpendicular to the glazing)
external shading correction factor (all directions)
alternatively: horizon angle
frame area fraction of windows

heating system

heat generation (heating)

type

energy carrier

location

control temperature

further specification

thermal power

heat distribution (heating)

type

location

control temperature

electric consumption pump

heating pipes (if detailed input required)

string 1

pipe length
insulation thickness
alternatively: U-value

string 2

pipe length
insulation thickness
alternatively: U-value

string 3

pipe length
insulation thickness
alternatively: U-value

heat emission (heating)

type

control

2-0	2-11	2-12	2-13	2-21	2-22
basis	hg-bnc	hg-pellet	hg-hp	dhw-el	dhw-sol
basis	variation heat generator	variation heat generator	variation heat generator	variation hot water system	variation hot water system
condensing boiler for heating and hot water + exhaust ventilation system	low temperature boiler (non-condensing)	wood pellet boiler	electric heat pump	decentral electric	thermal solar system
building					
thermal envelope					
envelope surface area					
thermal bridges					
air-tightness					
solar gains					
total solar energy transmittance (for radiation perpendicular to the glazing)					
external shading correction factor (all directions)					
alternatively: horizon angle					
frame area fraction of windows					
heating system					
heat generation (heating)					
type					
energy carrier					
location					
control temperature					
further specification					
thermal power					
heat distribution (heating)					
type					
location					
control temperature					
electric consumption pump					
heating pipes (if detailed input required)					
string 1					
pipe length					
insulation thickness					
alternatively: U-value					
string 2					
pipe length					
insulation thickness					
alternatively: U-value					
string 3					
pipe length					
insulation thickness					
alternatively: U-value					
heat emission (heating)					
type					
control					

variant

variant N°

variant name

variant type

description

hot water system**heat generation**

type

energy carrier

location

further specification

heat storage

type

location

volume

heat loss per day

heat distribution

type

location

temperature

electric consumption pump

heating pipes (if detailed input required)**string 1**

pipe length

insulation thickness

alternatively: U-value

string 2

pipe length

insulation thickness

alternatively: U-value

string 3

pipe length

insulation thickness

alternatively: U-value

ventilation system

type

specification

2-0	2-11	2-12	2-13	2-21	2-22
basis	hg-bnc	hg-pellet	hg-hp	dhw-el	dhw-sol
basis	variation heat generator	variation heat generator	variation heat generator	variation hot water system	variation hot water system
condensing boiler for heating and hot water + exhaust ventilation system	low temperature boiler (non-condensing)	wood pellet boiler	electric heat pump	decentral electric	thermal solar system
combined with heat generator for space heating (see above)	combined with heat generator for space heating (see above)	combined with heat generator for space heating (see above)	combined with heat generator for space heating (see above)	electric water heaters	combined with heat generator for space heating (see above) + additional thermal solar system
(see above)	(see above)	(see above)	(see above)	electricity	(see above)
(see above)	(see above)	(see above)	(see above)	inside thermal envelope	(see above)
hot water storage	= var. 2-0	= var. 2-0	= var. 2-0	none	= var. 2-0
central heating room (cellar, outside the thermal envelope)	= var. 2-0	= var. 2-0	= var. 2-0	-	= var. 2-0
500 liter	= var. 2-0	= var. 2-0	= var. 2-0	-	500 liter + 700 liter solar buffer
2,8 kWh/d	= var. 2-0	= var. 2-0	= var. 2-0	-	2,8 + 3,2 kWh/d
hot water circulation	= var. 2-0	= var. 2-0	= var. 2-0	pipes without hot water circulation	= var. 2-0
completely inside of the thermal envelope, vertical central string	= var. 2-0	= var. 2-0	= var. 2-0	In the kitchen and in the bathroom	= var. 2-0
60°C	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0
electric power = 60 W / running time = 24 h/d x 365 d/a	= var. 2-0	= var. 2-0	= var. 2-0	none	= var. 2-0
main string / heating room	= var. 2-0	= var. 2-0	= var. 2-0	none	= var. 2-0
2 pipes x 5 m	= var. 2-0	= var. 2-0	= var. 2-0	-	= var. 2-0
20 mm	= var. 2-0	= var. 2-0	= var. 2-0	-	= var. 2-0
0,20 W/(m²K)	= var. 2-0	= var. 2-0	= var. 2-0	-	= var. 2-0
main string / vertical	= var. 2-0	= var. 2-0	= var. 2-0	none	= var. 2-0
2 pipes x 11 m	= var. 2-0	= var. 2-0	= var. 2-0	-	= var. 2-0
20 mm	= var. 2-0	= var. 2-0	= var. 2-0	-	= var. 2-0
0,20 W/(m²K)	= var. 2-0	= var. 2-0	= var. 2-0	-	= var. 2-0
distribution to taps in bathrooms / WCs and kitchens	= var. 2-0	= var. 2-0	= var. 2-0	distribution to taps in bathroom and kitchen of each apartment	= var. 2-0
2 pipes x 75 m	= var. 2-0	= var. 2-0	= var. 2-0	1 pipe x 75 m	= var. 2-0
20 mm	= var. 2-0	= var. 2-0	= var. 2-0	10 mm	= var. 2-0
0,20 W/(m²K)	= var. 2-0	= var. 2-0	= var. 2-0	0,30 W/(m²K)	= var. 2-0
exhaust ventilation system	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0
DC fan	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0

Variants basis, vent-nomec, vent-rec, sys-el, sys-sol/rec

variant

variant N°
variant name
variant type

description

building

thermal envelope

envelope surface area
thermal bridges
air-tightness

solar gains

total solar energy transmittance (for radiation perpendicular to the gl.)
external shading correction factor (all directions)
alternatively: horizon angle
frame area fraction of windows

heating system

heat generation (heating)

type
energy carrier
location
control temperature
further specification
thermal power

heat distribution (heating)

type
location
control temperature
electric consumption pump

heating pipes (if detailed input required)

string 1

pipe length
insulation thickness
alternatively: U-value

string 2

pipe length
insulation thickness
alternatively: U-value

string 3

pipe length
insulation thickness
alternatively: U-value

heat emission (heating)

type
control

2-0	2-31	2-32	2-41	2-42
basis	vent-nomec	vent-rec	sys-el	sys-sol/rec
basis	variation ventilation	variation ventilation	variation heating and hot water system	variation hot water and ventilation system
condensing boiler for heating and hot water + exhaust ventilation system	no mechanical ventilation system	ventilation system with heat recovery	electric resistance system	solar dhw system + ventilation system with heat recovery
definition see plans (+ table with outside envelope areas, if applicable)				
no relevant constructive thermal bridges				
blower door measurement: $n_{50} \leq 1,5 \text{ h}^{-1}$	no blower door measurement	blower door measurement: $n_{50} \leq 1,5 \text{ h}^{-1}$	blower door measurement: $n_{50} \leq 1,5 \text{ h}^{-1}$	blower door measurement: $n_{50} \leq 1,5 \text{ h}^{-1}$
0.6				
0.6				
30°				
0.3				
condensing boiler	= var. 2-0	= var. 2-0	direct electric heating (electrical resistance)	= var. 2-0
natural gas	= var. 2-0	= var. 2-0	electricity	= var. 2-0
central heating room (cellar, outside the thermal envelope)	= var. 2-0	= var. 2-0	decentral	= var. 2-0
adjusted in dependence of outdoor temperature	= var. 2-0	= var. 2-0		= var. 2-0
maximum values for supply / return temperature: 70°C / 55°C	= var. 2-0	= var. 2-0		= var. 2-0
30 kW	= var. 2-0	= var. 2-0		= var. 2-0
water pipes	= var. 2-0	= var. 2-0	none	= var. 2-0
pipes between heat generator and vertical string outside the thermal envelope (non-heated cellar), vertical central string and distribution in all storeys inside the thermal envelope	= var. 2-0	= var. 2-0		= var. 2-0
control of heat distribution temperature according to outdoor air temperature	= var. 2-0	= var. 2-0	thermostatic control	= var. 2-0
electric power = 160 W / running time = 20 h/d x 365 d/a	= var. 2-0	= var. 2-0	-	= var. 2-0
main string / heating room (outside thermal envelope)	= var. 2-0	= var. 2-0	-	= var. 2-0
2 pipes x 5 m	= var. 2-0	= var. 2-0	-	= var. 2-0
20 mm	= var. 2-0	= var. 2-0	-	= var. 2-0
0,20 W/(m²K)	= var. 2-0	= var. 2-0	-	= var. 2-0
main string / vertical	= var. 2-0	= var. 2-0	-	= var. 2-0
2 pipes x 11 m	= var. 2-0	= var. 2-0	-	= var. 2-0
20 mm	= var. 2-0	= var. 2-0	-	= var. 2-0
0,20 W/(m²K)	= var. 2-0	= var. 2-0	-	= var. 2-0
distribution in rooms	= var. 2-0	= var. 2-0	-	= var. 2-0
2 pipes x 40 m x 4 storeys	= var. 2-0	= var. 2-0	-	= var. 2-0
-	= var. 2-0	= var. 2-0	-	= var. 2-0
0,40 W/(m²K)	= var. 2-0	= var. 2-0	-	= var. 2-0
radiators	= var. 2-0	= var. 2-0	direct	= var. 2-0
thermostatic valves (regulation range: 2K)	= var. 2-0	= var. 2-0	thermostatic control	= var. 2-0

variant

variant N°

variant name

variant type

description

hot water system**heat generation**

type

energy carrier

location

further specification

heat storage

type

location

volume

heat loss per day

heat distribution

type

location

temperature

electric consumption pump

heating pipes (if detailed input required)**string 1**

pipe length
insulation thickness
alternatively: U-value

string 2

pipe length
insulation thickness
alternatively: U-value

string 3

pipe length
insulation thickness
alternatively: U-value

ventilation system

type

specification

2-0	2-31	2-32	2-41	2-42
basis	vent-nomec	vent-rec	sys-el	sys-sol/rec
basis	variation ventilation	variation ventilation	variation heating and hot water system	variation hot water and ventilation system
condensing boiler for heating and hot water + exhaust ventilation system	no mechanical ventilation system	ventilation system with heat recovery	electric resistance system	solar dhw system + ventilation system with heat recovery
combined with heat generator for space heating (see above)	= var. 2-0	= var. 2-0	electric water heaters	combined with heat generator for space heating (see above) + additional thermal solar system
(see above)	= var. 2-0	= var. 2-0	electricity	(see above)
(see above)	= var. 2-0	= var. 2-0	inside thermal envelope	(see above)
hot water storage	= var. 2-0	= var. 2-0	none	= var. 2-0
central heating room (cellar, outside the thermal envelope)	= var. 2-0	= var. 2-0	-	= var. 2-0
500 liter	= var. 2-0	= var. 2-0	-	500 liter + 700 liter solar buffer
2,8 kWh/d	= var. 2-0	= var. 2-0	-	2,8 + 3,2 kWh/d
hot water circulation	= var. 2-0	= var. 2-0	pipes without hot water circulation	= var. 2-0
completely inside of the thermal envelope, vertical central string	= var. 2-0	= var. 2-0	in the kitchen and in the bathroom	= var. 2-0
60°C	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0
electric power = 60 W / running time = 24 h/d x 365 d/a	= var. 2-0	= var. 2-0	none	= var. 2-0
main string / heating room	= var. 2-0	= var. 2-0	none	= var. 2-0
2 pipes x 5 m	= var. 2-0	= var. 2-0	-	= var. 2-0
20 mm	= var. 2-0	= var. 2-0	-	= var. 2-0
0,20 W/(m²K)	= var. 2-0	= var. 2-0	-	= var. 2-0
main string / vertical	= var. 2-0	= var. 2-0	none	= var. 2-0
2 pipes x 11 m	= var. 2-0	= var. 2-0	-	= var. 2-0
20 mm	= var. 2-0	= var. 2-0	-	= var. 2-0
0,20 W/(m²K)	= var. 2-0	= var. 2-0	-	= var. 2-0
distribution to taps in bathrooms / WCs and kitchens	= var. 2-0	= var. 2-0	distribution to taps in bathroom and kitchen of each apartment	= var. 2-0
2 pipes x 75 m	= var. 2-0	= var. 2-0	1 pipe x 75 m	= var. 2-0
20 mm	= var. 2-0	= var. 2-0	10 mm	= var. 2-0
0,20 W/(m²K)	= var. 2-0	= var. 2-0	0,30 W/(m²K)	= var. 2-0
exhaust ventilation system	none	ventilation system with heat recovery	= var. 2-0	ventilation system with heat recovery
DC fan	-	heat recovery 80%, DC fan	= var. 2-0	heat recovery 80%, DC fan

Appendix 2d: Country sheets

Applied method

Country	Germany
Region	whole country
Type of requirements / method used to proof the compliance	Calculation according to the German Energy Saving Ordinance (Energieeinsparverordnung EnEV 2007) simplified method (EnEV vereinfachtes Verfahren) calculation building: seasonal balance (according to DIN V 4108-6) calculation system: table values (according to DIN V 4701-10 Annex C) Requirements to be complied: maximum values for thermal transmittance and primary energy demand
Requirements in force since	October 2007

Resulting U-values

Model building N°		2										
Building type		apartment building										
Variant N°		2-0	2-11	2-12	2-13	2-21	2-22	2-31	2-32	2-41	2-42	
variant name		basis	hg-bnc	hg-pellet	hg-hp	dhw-el	dhw-sol	vent-nomec	vent-rec	sys-el	sys-sol/rec	
U-values		U-value defined for temperature difference between room and ...										
tilted roof	external air	0,25	0,2	0,22	0,22	0,2	0,22	0,2	0,22	0,08	0,22	[W/(m²K)]
flat roof	external air	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,08	0,3	[W/(m²K)]
dormer roof	external air	0,4	0,4	0,3	0,3	0,3	0,3	0,3	0,3	0,08	0,3	[W/(m²K)]
walls	external air	0,3	0,24	0,5	0,5	0,33	0,5	0,26	0,5	0,08	0,5	[W/(m²K)]
dormer walls	external air	0,4	0,4	0,3	0,3	0,3	0,3	0,3	0,3	0,08	0,3	[W/(m²K)]
cellar ceiling	cellar air or soil	0,4	0,4	0,5	0,5	0,4	0,5	0,4	0,5	0,08	0,5	[W/(m²K)]
floor to soil	cellar air or soil	0,4	0,4	0,5	0,5	0,4	0,5	0,4	0,5	0,08	0,5	[W/(m²K)]
walls to soil	cellar air or soil	0,4	0,4	0,5	0,5	0,4	0,5	0,4	0,5	0,08	0,5	[W/(m²K)]
walls to cellar	cellar air or soil	0,4	0,4	0,5	0,5	0,4	0,5	0,4	0,5	0,08	0,5	[W/(m²K)]
door to cellar	cellar air or soil	3	3	3	3	3	3	3	3	1,5	3	[W/(m²K)]
outside door	external air	2	2	2	2	2	2	2	2	1,5	2	[W/(m²K)]
windows	external air	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	0,8	1,5	[W/(m²K)]
Restricting limit		maximum primary energy demand	maximum primary energy demand	maximum heat transfer coefficient	maximum heat transfer coefficient		maximum heat transfer coefficient		maximum heat transfer coefficient		maximum heat transfer coefficient	
Remarks												

Mean heat transmission losses (basis for cross country comparison)

Element	element area		heat transfer coefficient									
	[m²]	correction factor (only for cross-country comparison)	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
tilted roof	150,4	1	37,6	30,1	33,1	33,1	30,1	33,1	30,1	33,1	12,0	33,1
flat roof	36,7	1	11,0	11,0	11,0	11,0	11,0	11,0	11,0	11,0	2,9	11,0
dormer roof	7,5	1	3,0	3,0	2,3	2,3	2,3	2,3	2,3	2,3	0,6	2,3
walls	454,4	1	136,3	109,1	227,2	227,2	150,0	227,2	118,1	227,2	36,4	227,2
dormer walls	4,4	1	1,8	1,8	1,3	1,3	1,3	1,3	1,3	1,3	0,4	1,3
cellar ceiling	173,5	0,6	41,6	41,6	52,1	52,1	41,6	52,1	41,6	52,1	8,3	52,1
floor to soil	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
walls to soil	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
walls to cellar	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
door to cellar	0	0,6	-	-	-	-	-	-	-	-	0,0	-
outside door	2,1	1	-	-	-	-	-	-	-	-	3,2	-
windows	127,4	1	191,1	191,1	191,1	191,1	191,1	191,1	191,1	191,1	101,9	191,1
sum	956,4		422	388	518	518	427	518	396	518	166	518
Mean heat transmission losses per m² envelope			0,44	0,41	0,54	0,54	0,45	0,54	0,41	0,54	0,17	0,54
												[W/(m²K)]

Applied method

Country
Region

Austria

whole country

Type of requirements /
method used to proof the compliance

In Austria the relevant regulation is the net energy demand for heating per m² depending on the proportion of building volume to building surface ($l_v = V/A$). The requirements are regulated in the OIB directive 6 "Energieeinsparung und Wärmeschutz" from April 2007 and are calculated with a reference climate with 3.400 degree days. The calculation method is defined in the Austrian Standard ÖNORM B 8110-6, which is based on the ISO EN 13790.. Main estimations, which were not provided: "heavy construction" (brick or concrete) and air exchange rate 0,4/h with window ventilation. The heating system has no influence on the U-Values. The current requirement (until 31.12.2009): $HWB = 26 * (1 + 2/l_v)$. The data of the model building: $l_v = 1,92m$; $HWB < 52,94 \text{ kWh/m}^2a$.

Requirements in force since

April 2007

Resulting U-values

Model building N°
Building type

2

apartment building

Variant N°

variant name

U-values

U-value defined for
temperature difference
between room and ...

tilted roof

external air

0,2

0,2

0,2

0,2

0,2

0,2

0,2

0,2

0,2

0,2

0,2

[W/(m²K)]

flat roof

external air

0,2

0,2

0,2

0,2

0,2

0,2

0,2

0,2

0,2

0,2

0,2

[W/(m²K)]

dormer roof

external air

0,2

0,2

0,2

0,2

0,2

0,2

0,2

0,2

0,2

0,2

0,2

[W/(m²K)]

walls

external air

0,35

0,35

0,35

0,35

0,35

0,35

0,35

0,35

0,35

0,35

0,35

[W/(m²K)]

dormer walls

external air

0,7

0,7

0,7

0,7

0,7

0,7

0,7

0,7

0,7

0,7

0,7

[W/(m²K)]

cellar ceiling

cellar air or soil

0,4

0,4

0,4

0,4

0,4

0,4

0,4

0,4

0,4

0,4

0,4

[W/(m²K)]

floor to soil

cellar air or soil

0,4

0,4

0,4

0,4

0,4

0,4

0,4

0,4

0,4

0,4

0,4

[W/(m²K)]

walls to soil

cellar air or soil

0,4

0,4

0,4

0,4

0,4

0,4

0,4

0,4

0,4

0,4

0,4

[W/(m²K)]

walls to cellar

cellar air or soil

0,6

0,6

0,6

0,6

0,6

0,6

0,6

0,6

0,6

0,6

0,6

[W/(m²K)]

door to cellar

cellar air or soil

2,5

2,5

2,5

2,5

2,5

2,5

2,5

2,5

2,5

2,5

2,5

[W/(m²K)]

outside door

external air

1,7

1,7

1,7

1,7

1,7

1,7

1,7

1,7

1,7

1,7

1,7

[W/(m²K)]

windows

external air

1,4

1,4

1,4

1,4

1,4

1,4

1,4

1,4

1,4

1,4

1,4

[W/(m²K)]

Restricting limit

heat need for
space
heating

heat need for
space
heating

heat need for
space
heating

heat need for
space
heating

heat need for
space
heating

heat need for
space
heating

heat need for
space
heating

heat need for
space
heating

heat need for
space
heating

heat need for
space
heating

heat need for
space
heating

Remarks

Mean heat transmission losses (basis for cross country comparison)

Element	element area	correction factor (only for cross- country comparison)	heat transfer coefficient									
			[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
tilted roof	150,4	1	30,1	30,1	30,1	30,1	30,1	30,1	30,1	30,1	30,1	30,1
flat roof	36,7	1	7,3	7,3	7,3	7,3	7,3	7,3	7,3	7,3	7,3	7,3
dormer roof	7,5	1	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5
walls	454,4	1	159,0	159,0	159,0	159,0	159,0	159,0	159,0	159,0	159,0	159,0
dormer walls	4,4	1	3,1	3,1	3,1	3,1	3,1	3,1	3,1	3,1	3,1	3,1
cellar ceiling	173,5	0,6	41,6	41,6	41,6	41,6	41,6	41,6	41,6	41,6	41,6	41,6
floor to soil	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
walls to soil	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
walls to cellar	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
door to cellar	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
outside door	2,1	1	3,6	3,6	3,6	3,6	3,6	3,6	3,6	3,6	3,6	3,6
windows	127,4	1	178,4	178,4	178,4	178,4	178,4	178,4	178,4	178,4	178,4	178,4
sum	956,4		425	425	425	425	425	425	425	425	425	425
Mean heat transmission losses per m² envelope			0,44	0,44	0,44	0,44	0,44	0,44	0,44	0,44	0,44	0,44

[W/(m²K)]

Applied method

Country	Czech Republic
Region	whole country
Type of requirements / method used to proof the compliance	Calculation method according to the requirements of the Act no. 406/2000 Coll. on Energy Management, its amendment no. 177/2006 Coll. as amended by no. 406/2006 Coll. and the Code of Practice no. 148/2007 Coll. on Energy Demand of Buildings as amended. A specific technical regulation in this field is the Czech standard ČSN 73 0540 "Thermal Protection of Buildings" (and a set of relevant standards), which the abovementioned statutes are related to and make its requirements binding. Valid requirements for U values are set forth in the second part of the standard i.e. in ČSN 73 0540-2 as of April 2007. Two groups of U values are prescribed: recommended values and required values. Required U-values were used in this table.
Requirements in force since	April 2007

Resulting U-values

Model building N°		2									
Building type		apartment building									
Variant N°		2-0	2-11	2-12	2-13	2-21	2-22	2-31	2-32	2-41	2-42
variant name		basis	hg-bnc	hg-pellet	hg-hp	dhw-el	dhw-sol	vent-nomec	vent-rec	sys-el	sys-sol/rec
U-values	U-value defined for temperature difference between room and ...										
tilted roof	external air	0,24	0,24	0,24	0,24	0,24	0,24	0,24	0,24	0,24	[W/(m²K)]
flat roof	external air	0,24	0,24	0,24	0,24	0,24	0,24	0,24	0,24	0,24	[W/(m²K)]
dormer roof	external air	0,24	0,24	0,24	0,24	0,24	0,24	0,24	0,24	0,24	[W/(m²K)]
walls	external air	0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38	[W/(m²K)]
dormer walls	external air	0,30	0,30	0,30	0,30	0,30	0,30	0,30	0,30	0,30	[W/(m²K)]
cellar ceiling	cellar air or soil	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05	[W/(m²K)]
floor to soil	cellar air or soil	0,85	0,85	0,85	0,85	0,85	0,85	0,85	0,85	0,85	[W/(m²K)]
walls to soil	cellar air or soil	0,85	0,85	0,85	0,85	0,85	0,85	0,85	0,85	0,85	[W/(m²K)]
walls to cellar	cellar air or soil	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	[W/(m²K)]
door to cellar	cellar air or soil	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	[W/(m²K)]
outside door	external air	1,7	1,7	1,7	1,7	1,7	1,7	1,7	1,7	1,7	[W/(m²K)]
windows	external air	1,7	1,7	1,7	1,7	1,7	1,7	1,7	1,7	1,7	[W/(m²K)]
Restricting limit											
Remarks		*U= 0,30 for the light roof with slope over 45° U=0,38 for the heavy roof with slope over 45°	** provided the temperature difference between heated area and cellar is not higher than 10°C								

Mean heat transmission losses (basis for cross country comparison)

Element	element area		heat transfer coefficient									
	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
tilted roof	150,4	1	36,1	36,1	36,1	36,1	36,1	36,1	36,1	36,1	36,1	36,1
flat roof	36,7	1	8,8	8,8	8,8	8,8	8,8	8,8	8,8	8,8	8,8	8,8
dormer roof	7,5	1	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8
walls	454,4	1	172,7	172,7	172,7	172,7	172,7	172,7	172,7	172,7	172,7	172,7
dormer walls	4,4	1	-	-	-	-	-	-	-	-	-	-
cellar ceiling	173,5	0,6	109,3	109,3	109,3	109,3	109,3	109,3	109,3	109,3	109,3	109,3
floor to soil	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
walls to soil	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
walls to cellar	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
door to cellar	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
outside door	2,1	1	3,6	3,6	3,6	3,6	3,6	3,6	3,6	3,6	3,6	3,6
windows	127,4	1	216,6	216,6	216,6	216,6	216,6	216,6	216,6	216,6	216,6	216,6
sum	956,4		549	549	549	549	549	549	549	549	549	549
Mean heat transmission losses per m² envelope			0,57	0,57	0,57	0,57	0,57	0,57	0,57	0,57	0,57	[W/(m²K)]

Applied method

Country	Poland
Region	whole country
Type of requirements / method used to proof the compliance	Values defined in "Technical conditions to be fulfilled by new and modernised buildings". There are no differences in required U values for different types of heating, but there are differences between rooms with different internal temperature. Ex. different type of living rooms that computational temperature is over 16 C, for other room (like halls, staircases, cellars) it is between 8 an 16 C.
Requirements in force since	October 2002

Resulting U-values

Model building N°		2										
Building type		apartment building										
Variant N°		2-0	2-11	2-12	2-13	2-21	2-22	2-31	2-32	2-41	2-42	
variant name		basis	hg-bnc	hg-pellet	hg-hp	dhw-el	dhw-sol	vent-nomec	vent-rec	sys-el	sys-sol/rec	
U-values		U-value defined for temperature difference between room and ...										
tilted roof	external air	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	[W/(m²K)]
flat roof	external air	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	[W/(m²K)]
dormer roof	external air	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	[W/(m²K)]
walls	external air	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	[W/(m²K)]
dormer walls	external air	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	[W/(m²K)]
cellar ceiling	cellar air or soil	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	[W/(m²K)]
floor to soil	cellar air or soil	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	[W/(m²K)]
walls to soil	cellar air or soil	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	[W/(m²K)]
walls to cellar	cellar air or soil	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	[W/(m²K)]
door to cellar	cellar air or soil	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6	[W/(m²K)]
outside door	external air	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6	[W/(m²K)]
windows	external air	2	2	2	2	2	2	2	2	2	2	[W/(m²K)]
Restricting limit		maximum primary energy demand	maximum primary energy demand	maximum heat transfer coefficient	maximum heat transfer coefficient		maximum heat transfer coefficient		maximum heat transfer coefficient		maximum heat transfer coefficient	
Remarks												

Mean heat transmission losses (basis for cross country comparison)

Element	element area	correction factor (only for cross-country comparison)	heat transfer coefficient									
	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
tilted roof	150,4	1	45,1	45,1	45,1	45,1	45,1	45,1	45,1	45,1	45,1	45,1
flat roof	36,7	1	11,0	11,0	11,0	11,0	11,0	11,0	11,0	11,0	11,0	11,0
dormer roof	7,5	1	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3
walls	454,4	1	136,3	136,3	136,3	136,3	136,3	136,3	136,3	136,3	136,3	136,3
dormer walls	4,4	1	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3
cellar ceiling	173,5	0,6	62,5	62,5	62,5	62,5	62,5	62,5	62,5	62,5	62,5	62,5
floor to soil	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
walls to soil	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
walls to cellar	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
door to cellar	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
outside door	2,1	1	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5
windows	127,4	1	254,8	254,8	254,8	254,8	254,8	254,8	254,8	254,8	254,8	254,8
sum	956,4		519	519	519	519	519	519	519	519	519	519
Mean heat transmission losses per m² envelope			0,54	0,54	0,54	0,54	0,54	0,54	0,54	0,54	0,54	[W/(m²K)]

Applied method

Country	Sweden
Region	Lund
Type of requirements / method used to proof the compliance	From the Swedish regulation for building (Regelsamling för byggande - Boverkets byggregler, BBR, 2006) Requirements for housing Maximum specific energy consumption 110 kWh/m ² floor area (internal) in south Sweden, 130 kWh/m ² floor area (internal) in north Sweden. Household electricity is not included in the specific energy consumption. For one ore two family houses with direct-acting electric heating system is the requirement for maximum specific energy consumption 75 kWh/m ² floor area (internal) in south Sweden, 95 kWh/m ² floor area (internal) in north Sweden. Household electricity is not included in the specific energy consumption. Maximum Um for the total building 0,50 W/m ² K Minimum ventilation 0.35 l/s m ² 2006
Requirements in force since	

Resulting U-values

Model building N°		2										
Building type		apartment building										
Variant N°		2-0	2-11	2-12	2-13	2-21	2-22	2-31	2-32	2-41	2-42	
variant name		basis	hg-bnc	hg-pellet	hg-hp	dhw-el	dhw-sol	vent-nomec	vent-rec	sys-el	sys-sol/rec	
U-values		U-value defined for temperature difference between room and ...										
tilted roof	external air	0,15	0,15	0,1	0,2	0,2	0,2	-	0,2	0,2	0,2	[W/(m²K)]
flat roof	external air	0,12	0,12	0,1	0,2	0,12	0,2	-	0,2	0,2	0,2	[W/(m²K)]
dormer roof	external air	0,15	0,15	0,1	0,2	0,2	0,2	-	0,2	0,2	0,2	[W/(m²K)]
walls	external air	0,15	0,15	0,12	0,2	0,2	0,2	-	0,2	0,2	0,2	[W/(m²K)]
dormer walls	external air	0,15	0,15	0,12	0,2	0,2	0,2	-	0,2	0,2	0,2	[W/(m²K)]
cellar ceiling	cellar air or soil	0,67	0,67	0,17	0,67	0,67	0,67	-	0,67	0,67	0,67	[W/(m²K)]
floor to soil	cellar air or soil	0,25	0,25	0,18	0,25	0,25	0,25	-	0,25	0,25	0,25	[W/(m²K)]
walls to soil	cellar air or soil	0,34	0,26	0,34	0,26	0,26	0,26	-	0,26	0,26	0,26	[W/(m²K)]
walls to cellar	cellar air or soil	2,08	2,08	0,53	2,08	2,08	2,08	-	2,08	2,08	2,08	[W/(m²K)]
door to cellar	cellar air or soil	1,1	1,1	1,1	1,1	1,1	1,1	-	1,1	1,1	1,1	[W/(m²K)]
outside door	external air	1,1	1,1	1,1	1,1	1,1	1,1	-	1,1	1,1	1,1	[W/(m²K)]
windows	external air	1,2	1,2	1,2	1,5	1,5	1,5	-	1,5	1,5	1,5	[W/(m²K)]
Restricting limit		Maximum specific energy consumption 110 kWh/m2 floor area	Maximum specific energy consumption 110 kWh/m2 floor area	Maximum specific energy consumption 110 kWh/m2 floor area	Maximum Um for the total building 0,50 W/m²K	Maximum Um for the total building 0,50 W/m²K	Maximum Um for the total building 0,50 W/m²K		Maximum Um for the total building 0,50 W/m²K	Maximum Um for the total building 0,50 W/m²K	Maximum Um for the total building 0,50 W/m²K	
Remarks		calculated energy consumption for the building 103 kWh/m². (Um = 0,43 [W/(m²K)])		calculated energy consumption for the building 109 kWh/m². (Um = 0,43 [W/(m²K)])	calculated energy consumption for the building 69 kWh/m². heat pump	calculated energy consumption for the building 104 kWh/m². (Um = 0,50 [W/(m²K)])	Solar energy is "free" energy. Calculated energy consumption for the building 81 kWh/m²		calculated energy consumption for the building 79 kWh/m². With exhaust air heat pump	calculated energy consumption for the building 104 kWh/m². (Um = 0,50 [W/(m²K)])		

Mean heat transmission losses (basis for cross country comparison)

Element	element area <small>(correction factor only for cross-country comparison)</small>		heat transfer coefficient										
	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	
tilted roof	150,4	1	22,6	22,6	15,0	30,1	30,1	30,1	-	-	30,1	30,1	
flat roof	36,7	1	4,4	4,4	3,7	7,3	4,4	7,3	-	7,3	7,3	7,3	
dormer roof	7,5	1	1,1	1,1	0,8	1,5	1,5	1,5	-	1,5	1,5	1,5	
walls	454,4	1	68,2	68,2	54,5	90,9	90,9	90,9	-	90,9	90,9	90,9	
dormer walls	4,4	1	0,7	0,7	0,5	0,9	0,9	0,9	-	0,9	0,9	0,9	
cellar ceiling	173,5	0,6	69,7	69,7	17,7	69,7	69,7	69,7	-	69,7	69,7	69,7	
floor to soil	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	-	0,0	0,0	0,0	
walls to soil	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	-	0,0	0,0	0,0	
walls to cellar	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	-	0,0	0,0	0,0	
door to cellar	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	-	0,0	0,0	0,0	
outside door	2,1	1	2,3	2,3	2,3	2,3	2,3	2,3	-	2,3	2,3	2,3	
windows	127,4	1	152,9	152,9	152,9	191,1	191,1	191,1	-	191,1	191,1	191,1	
sum	956,4		322	322	247	394	391	394	0	364	394	394	
Mean heat transmission losses per m² envelope			0,34	0,34	0,26	0,41	0,41	0,41	-	0,38	0,41	0,41	[W/(m²K)]

Applied method

Country	Denmark
Region	whole country
Type of requirements / method used to proof the compliance	<p>Monthly calculation according to the SBI direction 213, Calculation of buildings energy demand.</p> <ul style="list-style-type: none"> - heating demand is based on prEN ISO 13790:2005, which elaborates on EN 832 and EN ISO 13790. - cooling demand is based on prEN ISO 13790:2005. - heat loss from installations is calculated as defined in prEN 15316 part 2.3 og part 3.2. - boilers is calculated according to prEN 15316 part 4.1 methode II and part 3.3. - calculation tool: Be06, version 2,7,5,3 <p>Requirements to be complied: maximum primary energy demand, maximum values for overall thermal transmittance and maximum U-values for constructions.</p> <p>This new building must have an energy consumption less than 70+2200/A, having a dimensioning transmission losse less than 8 W/m² through the thermal envelope or meet maximum U-values for the</p>
Requirements in force since	January 2006

Resulting U-values

Model building N°		2										
Building type		apartment building										
Variant N°												
variant name												
		2-0	2-11	2-12	2-13	2-21	2-22	2-31	2-32	2-41	2-42	
		basis	hg-bnc	hg-pellet	hg-hp	dhw-el	dhw-sol	vent-nomec	vent-rec	sys-el	sys-sol/rec	
U-values		U-value defined for temperature difference between room and ...										
tilted roof	external air	0,15	-	0,09	0,17	0,09	0,17	-	0,12	< 0,08	0,2	[W/(m²K)]
flat roof	external air	0,15	-	0,1	0,2	0,1	0,25	-	0,15	< 0,08	0,2	[W/(m²K)]
dormer roof	external air	0,15	-	0,1	0,2	0,1	0,2	-	0,15	< 0,08	0,2	[W/(m²K)]
walls	external air	0,2	-	0,13	0,25	0,13	0,33	-	0,18	< 0,08	0,3	[W/(m²K)]
dormer walls	external air	0,4	-	0,3	0,4	0,3	0,4	-	0,4	< 0,08	0,4	[W/(m²K)]
cellar ceiling	cellar air or soil	0,3	-	0,17	0,3	0,17	0,3	-	0,3	< 0,08	0,3	[W/(m²K)]
floor to soil	cellar air or soil	0,3	-	0,3	0,3	0,3	0,3	-	0,3	< 0,08	0,3	[W/(m²K)]
walls to soil	cellar air or soil	0,25	-	0,19	0,25	0,19	0,3	-	0,25	< 0,08	0,3	[W/(m²K)]
walls to cellar	cellar air or soil	0,3	-	0,25	0,3	0,25	0,3	-	0,3	< 0,08	0,3	[W/(m²K)]
door to cellar	cellar air or soil	2	-	2	2	2	2	-	2	< 0,8	2	[W/(m²K)]
outside door	external air	2	-	2	2	2	2	-	2	< 0,8	2	[W/(m²K)]
windows	external air	1,46	-	1,39	1,46	1,15	2	-	1,46	< 0,8	1,8	[W/(m²K)]
Restricting limit		maximum primary energy demand and maximum U-values	n.a.	maximum primary energy demand and maximum U-values	maximum primary energy demand and maximum U-values	maximum primary energy demand and maximum U-values	maximum dimensioning heat transfer (8 W/m²K per m² thermal envelope, excl. windows and doors) and maximum U.L.	n.a.	maximum primary energy demand and maximum U-values	n.a.	maximum primary energy demand and maximum U-values	
Remarks			Non-condensing boilers are illegal in Denmark.	Unrealistic high insulation thickness of facades and roofs in a real building. Resuested due to high losses from DHW system (storage tank).		Unrealistic high insulation thickness of facades and roofs in a real building.	Anticipated 100 m² solar collector.	Mechanical exhaust ventilation in blocks of flats is the minimum legal ventilation in this type of buildings.	Ventilation air flow same as 2-11 and infiltration flow rate 0,13 l/s per m² gross floor area	Not possible to meet the requirements in the case of electric heating and DHW.		

Mean heat transmission losses (basis for cross country comparison)

Element	element area	correction factor (only for cross-country comparison)	heat transfer coefficient									
			[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
tilted roof	150,4	1	22,6	-	13,5	25,6	13,5	25,6	-	18,0	-	30,1
flat roof	36,7	1	5,5	-	3,7	7,3	3,7	9,2	-	5,5	-	7,3
dormer roof	7,5	1	1,1	-	0,8	1,5	0,8	1,5	-	1,1	-	1,5
walls	454,4	1	90,9	-	59,1	113,6	59,1	150,0	-	81,8	-	136,3
dormer walls	4,4	1	1,8	-	1,3	1,8	1,3	1,8	-	1,8	-	1,8
cellar ceiling	173,5	0,6	31,2	-	17,7	31,2	17,7	31,2	-	31,2	-	31,2
floor to soil	0	0,6	0,0	-	0,0	0,0	0,0	0,0	-	0,0	-	0,0
walls to soil	0	0,6	0,0	-	0,0	0,0	0,0	0,0	-	0,0	-	0,0
walls to cellar	0	0,6	0,0	-	0,0	0,0	0,0	0,0	-	0,0	-	0,0
door to cellar	0	0,6	0,0	-	0,0	0,0	0,0	0,0	-	0,0	-	0,0
outside door	2,1	1	4,2	-	4,2	4,2	4,2	4,2	-	4,2	-	4,2
windows	127,4	1	186,0	-	177,1	186,0	146,5	254,8	-	186,0	-	229,3
sum	956,4		343	0	277	371	247	478	0	330	0	442
Mean heat transmission losses per m² envelope			0,36	-	0,29	0,39	0,26	0,50	-	0,34	-	0,46 [W/(m²K)]

Applied method

Country	UK
Region	England & Wales
Type of requirements / method used to proof the compliance	SAP 2005 (www.bre.co.uk/sap2005) Seasonal energy balance Requirements to be complied with: maximum CO2 emissions, maximum U-values, minimum heating efficiency
Requirements in force since	2005

Resulting U-values

Model building N°		2										
Building type		apartment building										
Variant N°		2-0	2-11	2-12	2-13	2-21	2-22	2-31	2-32	2-41	2-42	
variant name		basis	hg-bnc	hg-pellet	hg-hp	dhw-el	dhw-sol	vent-nomec	vent-rec	sys-el	sys-sol/rec	
U-values		U-value defined for temperature difference between room and ...										
tilted roof	external air	0,11	-	0,25	0,25	0,11	0,25	0,16	0,25	0,11	0,25	[W/(m²K)]
flat roof	external air	0,11	-	0,25	0,25	0,11	0,25	0,16	0,25	0,11	0,25	[W/(m²K)]
dormer roof	external air	0,11	-	0,25	0,25	0,11	0,25	0,16	0,25	0,11	0,25	[W/(m²K)]
walls	external air	0,3	-	0,35	0,35	0,2	0,35	0,33	0,35	0,2	0,35	[W/(m²K)]
dormer walls	external air	0,3	-	0,35	0,35	0,2	0,35	0,33	0,35	0,2	0,35	[W/(m²K)]
cellar ceiling	external air											[W/(m²K)]
floor to soil	external air	0,25	-	0,25	0,25	0,2	0,25	0,25	0,25	0,2	0,25	[W/(m²K)]
walls to soil	external air											[W/(m²K)]
walls to cellar	external air											[W/(m²K)]
door to cellar	external air											[W/(m²K)]
outside door	external air	2,2	-	2,2	2,2	2	2,2	2	2,2	2	2,2	[W/(m²K)]
windows	external air	2,1	-	2,2	2,2	1,8	2,2	1,8	2,2	1,3	2,2	[W/(m²K)]
Restricting limit		maximum CO ₂ emissions		maximum U-values of elements	maximum U-values of elements	maximum CO ₂ emissions	maximum U-values of elements	maximum CO ₂ emissions	maximum U-values of elements	maximum CO ₂ emissions	maximum U-values of elements	
Remarks			not possible - minimum boiler efficiency is 86% (condensing)						maximum U-values of elements (although only small margin left on CO ₂ emissions)			

Mean heat transmission losses (basis for cross country comparison)

Element	element area	correction factor (only for cross-country comparison)	heat transfer coefficient										
	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	
tilted roof	150,4	1	16,5	-	37,6	37,6	16,5	37,6	24,1	37,6	16,5	37,6	
flat roof	36,7	1	4,0	-	9,2	9,2	4,0	9,2	5,9	9,2	4,0	9,2	
dormer roof	7,5	1	0,8	-	1,9	1,9	0,8	1,9	1,2	1,9	0,8	1,9	
walls	454,4	1	136,3	-	159,0	159,0	90,9	159,0	150,0	159,0	90,9	159,0	
dormer walls	4,4	1	1,3	-	1,5	1,5	0,9	1,5	1,5	1,5	0,9	1,5	
cellar ceiling	173,5	1	43,4	-	43,4	43,4	34,7	43,4	43,4	43,4	34,7	43,4	
floor to soil	0	1	0,0	-	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	
walls to soil	0	1	-	-	-	-	-	-	-	-	-	-	
walls to cellar	0	1	-	-	-	-	-	-	-	-	-	-	
door to cellar	0	1	-	-	-	-	-	-	-	-	-	-	
outside door	2,1	1	4,6	-	4,6	4,6	4,2	4,6	4,2	4,6	4,2	4,6	
windows	127,4	1	267,5	-	280,3	280,3	229,3	280,3	229,3	280,3	165,6	280,3	
sum	956,4		475	0	538	538	381	538	459	538	318	538	
Mean heat transmission losses per m² envelope			0,50	-	0,56	0,56	0,40	0,56	0,48	0,56	0,33	0,56	[W/(m²K)]

Applied method

Country	The Netherlands
Region	whole country
Type of requirements / method used to proof the compliance	<p>Energy use calculations for the heating season (October 1 - April 30) according to (for building as well as system):</p> <ul style="list-style-type: none"> * Dutch Standard NEN 5128: Energy performance of residential functions and residential buildings - Determination method (NNI, March 2004). * Dutch Guideline NPR 5129: Energy performance of residential functions and residential buildings - Calculation program (EPW) with handbook (NNI, April 2005). * EPW for Windows Version 2.02 (NNI, 2006) <p>Requirements to be met:</p> <ul style="list-style-type: none"> * EPC <= 0,8 (EPC = Energy Performance Coefficient, based on primary energy demand), and * Minimum Rc values (heat resistance) for thermal envelope (Rc >=2,5 m²K/W)
Requirements in force since	2006 (EPC <=0,8), 1992 (Rc >= 2,5 W/(m²K))

Resulting U-values

Model building N°		2										
Building type		apartment building										
Variant N°		2-0	2-11	2-12	2-13	2-21	2-22	2-31	2-32	2-41	2-42	
variant name		basis	hg-bnc	hg-pellet	hg-hp	dhw-el	dhw-sol	vent-nomec	vent-rec	sys-el	sys-sol/rec	
U-values	U-value defined for temperature difference between room and ...											
tilted roof	external air	< 0,08	< 0,08	< 0,08	0,24	< 0,08	0,12	0,1	0,19	< 0,08	0,19	[W/(m²K)]
flat roof	external air	< 0,08	< 0,08	< 0,08	0,24	< 0,08	0,12	0,1	0,19	< 0,08	0,19	[W/(m²K)]
dormer roof	external air	< 0,08	< 0,08	< 0,08	0,37	< 0,08	0,32	0,32	0,32	< 0,08	0,37	[W/(m²K)]
walls	external air	< 0,08	< 0,08	< 0,08	0,24	< 0,08	0,12	0,1	0,19	< 0,08	0,32	[W/(m²K)]
dormer walls	external air	< 0,08	< 0,08	< 0,08	0,37	< 0,08	0,32	0,32	0,32	< 0,08	0,37	[W/(m²K)]
cellar ceiling	cellar air or soil	< 0,08	< 0,08	< 0,08	0,23	< 0,08	0,12	0,1	0,19	< 0,08	0,23	[W/(m²K)]
floor to soil	cellar air or soil	< 0,08	< 0,08	< 0,08	0,37	< 0,08	0,37	0,37	0,37	< 0,08	0,37	[W/(m²K)]
walls to soil	cellar air or soil	< 0,08	< 0,08	< 0,08	0,37	< 0,08	0,37	0,37	0,37	< 0,08	0,37	[W/(m²K)]
walls to cellar	cellar air or soil	< 0,08	< 0,08	< 0,08	0,37	< 0,08	0,37	0,37	0,37	< 0,08	0,37	[W/(m²K)]
door to cellar	cellar air or soil	< 0,8	< 0,8	< 0,8	3,4	< 0,8	2	2	2	< 0,8	2	[W/(m²K)]
outside door	external air	< 0,8	< 0,8	< 0,8	2	< 0,8	2	2	2	< 0,8	2	[W/(m²K)]
windows	external air	< 0,8	< 0,8	< 0,8	1,8	< 0,8	1,2	0,8	1,3	< 0,8	2	[W/(m²K)]
Restricting limit		EPC<=0,80	EPC<=0,80	EPC<=0,80	EPC<=0,80	EPC<=0,80	EPC<=0,80	EPC<=0,80	EPC<=0,80	EPC<=0,80	EPC<=0,80	
Remarks	EPC=0,84, so not possible to meet EPC<=0,80 all heating pipes within thermal envelope	Not possible to meet EPC<=0,8. The effect of low performance of heating and ventilation system can not be compensated by improved U-values.	Wood pellet boiler is no option in Dutch calculation software (except for complicated procedure using 'declaration of quality'). Wood pellet boiler not used as primary heat generator in new.		Not possible to meet EPC<=0,8. The effect of low performance of heating system can not be compensated by improved U-values.				Efficiency heat recovery = 75%	Not possible to meet EPC<=0,8. The effect of low performance of heating system can not be compensated by improved U-values.	Efficiency heat recovery = 75%	

Mean heat transmission losses (basis for cross country comparison)

Element	element area	correction factor (only for cross-country comparison)	heat transfer coefficient										
	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	
tilted roof	150,4	1	-	-	-	36,1	-	18,0	15,0	28,6	-	28,6	
flat roof	36,7	1	-	-	-	8,8	-	4,4	3,7	7,0	-	7,0	
dormer roof	7,5	1	-	-	-	2,8	-	2,4	2,4	2,4	-	2,8	
walls	454,4	1	-	-	-	109,1	-	54,5	45,4	86,3	-	145,4	
dormer walls	4,4	1	-	-	-	1,6	-	1,4	1,4	1,4	-	1,6	
cellar ceiling	173,5	0,6	-	-	-	23,9	-	12,5	10,4	19,8	-	23,9	
floor to soil	0	0,6	-	-	-	0,0	-	0,0	0,0	0,0	-	0,0	
walls to soil	0	0,6	-	-	-	0,0	-	0,0	0,0	0,0	-	0,0	
walls to cellar	0	0,6	-	-	-	0,0	-	0,0	0,0	0,0	-	0,0	
door to cellar	0	0,6	-	-	-	0,0	-	0,0	0,0	0,0	-	0,0	
outside door	2,1	1	-	-	-	4,2	-	4,2	4,2	4,2	-	4,2	
windows	127,4	1	-	-	-	229,3	-	152,9	101,9	165,6	-	254,8	
sum	956,4		0	0	0	416	0	250	184	315	0	468	
Mean heat transmission losses per m² envelope			-	-	-	0,43	-	0,26	0,19	0,33	-	0,49	[W/(m²K)]

Applied method

Country	Belgium
Region	Flanders
Type of requirements / method used to proof the compliance	Method described in the decree of the 5th of march 2005. Three requirements are imposed : one limits the annual characteristic primary energy use for each dwelling, a second one limits the average thermal transmittance for the whole building, and a third one gives the maximal values of the thermal transmittance.
Requirements in force since	2005

Resulting U-values

Model building N°		2										
Building type		apartment building										
Variant N°		2-0	2-11	2-12	2-13	2-21	2-22	2-31	2-32	2-41	2-42	
variant name		basis	hg-bnc	hg-pellet	hg-hp	dhw-el	dhw-sol	vent-nomec	vent-rec	sys-el	sys-sol/rec	
U-values		U-value defined for temperature difference between room and ...										
tilted roof	external air	0,1	0,08	-	0,35	0,08	0,08	-	0,1	< 0,08	0,1	[W/(m²K)]
flat roof	external air	0,39	0,3	-	0,35	0,2	0,4	-	0,4	< 0,08	0,4	[W/(m²K)]
dormer roof	external air	0,1	0,08	-	0,4	0,08	0,08	-	0,1	< 0,08	0,4	[W/(m²K)]
walls	external air	0,15	0,12	-	0,49	0,15	0,36	-	0,34	< 0,08	0,5	[W/(m²K)]
dormer walls	external air	0,1	0,08	-	0,4	0,08	0,1	-	0,1	< 0,08	0,1	[W/(m²K)]
cellar ceiling	cellar air or soil	0,35	0,29	-	0,4	0,25	0,4	-	0,4	< 0,08	0,4	[W/(m²K)]
floor to soil	cellar air or soil	0,86	0,86	-	0,08	0,86	0,86	-	0,86	< 0,08	0,86	[W/(m²K)]
walls to soil	cellar air or soil	0,88	0,88	-	0,08	0,88	0,88	-	0,88	< 0,08	0,5	[W/(m²K)]
walls to cellar	cellar air or soil	0,79	0,79	-	0,08	0,79	0,79	-	0,79	< 0,08	0,5	[W/(m²K)]
door to cellar	cellar air or soil	2,9	2,9	-	2,9	2,9	2,9	-	2,9	< 0,8	2,9	[W/(m²K)]
outside door	external air	2,9	2,9	-	2,9	2,9	2,9	-	2,9	< 0,8	2,9	[W/(m²K)]
windows	external air	1,64	1,35	-	1,76	0,9	1,64	-	1,64	< 0,8	1,76	[W/(m²K)]
Restricting limit		Primary energy consumption	Primary energy consumption	-	Maximal average thermal transmittance	Primary energy consumption	Primary energy consumption for some apartments and maximal thermal transmittance for others	-	Primary energy consumption for some apartments and maximal thermal transmittance for others	-	Maximal average thermal transmittance	
Remarks				not possible to meet the requirements for the penthouse				Not allowed in Flanders		not possible to meet the requirements		

Mean heat transmission losses (basis for cross country comparison)

Element	element area		correction factor (only for cross-country comparison)	heat transfer coefficient									
	[m²]	[-]		[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	
tilted roof	150,4	1	15,0	12,0	-	52,6	12,0	12,0	-	15,0	-	15,0	
flat roof	36,7	1	14,3	11,0	-	12,8	7,3	14,7	-	14,7	-	14,7	
dormer roof	7,5	1	0,8	0,6	-	3,0	0,6	0,6	-	0,8	-	3,0	
walls	454,4	1	68,2	54,5	-	222,7	68,2	163,6	-	154,5	-	222,2	
dormer walls	4,4	1	0,4	0,4	-	1,8	0,4	0,4	-	0,4	-	0,4	
cellar ceiling	173,5	0,6	36,4	30,2	-	41,6	26,0	41,6	-	41,6	-	41,6	
floor to soil	0	0,6	0,0	0,0	-	0,0	0,0	0,0	-	0,0	-	0,0	
walls to soil	0	0,6	0,0	0,0	-	0,0	0,0	0,0	-	0,0	-	0,0	
walls to cellar	0	0,6	0,0	0,0	-	0,0	0,0	0,0	-	0,0	-	0,0	
door to cellar	0	0,6	0,0	0,0	-	0,0	0,0	0,0	-	0,0	-	0,0	
outside door	2,1	1	6,1	6,1	-	6,1	6,1	6,1	-	6,1	-	6,1	
windows	127,4	1	208,9	172,0	-	224,2	114,7	208,9	-	208,9	-	224,2	
sum	956,4		350	287	0	565	235	448	0	442	0	532	
Mean heat transmission losses per m² envelope			0,37	0,30	-	0,59	0,25	0,47	-	0,46	-	0,56	[W/(m²K)]

Applied method

Country	Luxembourg
Region	whole country
Type of requirements / method used to proof the compliance	The calculation has been done according to the Luxembourg "Règlement grand-ducal" (short: RGD) from 30.11.2007 (LuxEeB). The RDG gives minimum requirements for U-Values, air-tightness, thermal bridges, summer requirements, insulation of pipes for heat transfer / hot water transfer and specific fan power for ventilation. Additionally there are main requirements for the heating and primary energy consumption.
Requirements in force since	2008

Resulting U-values

Model building N°		2										
Building type		apartment building										
Variant N°		2-0	2-11	2-12	2-13	2-21	2-22	2-31	2-32	2-41	2-42	
variant name		basis	hg-bnc	hg-pellet	hg-hp	dhw-el	dhw-sol	vent-nomec	vent-rec	sys-el	sys-sol/rec	
U-values		U-value defined for temperature difference between room and ...										
tilted roof	external air	0,2	0,2	0,2	0,2	0,14	0,2	0,2	0,25	-	0,25	[W/(m²K)]
flat roof	external air	0,2	0,2	0,2	0,2	0,14	0,2	0,2	0,25	-	0,25	[W/(m²K)]
dormer roof	external air	0,2	0,2	0,2	0,2	0,14	0,2	0,2	0,25	-	0,25	[W/(m²K)]
walls	external air	0,24	0,24	0,25	0,25	0,13	0,25	0,215	0,32	-	0,32	[W/(m²K)]
dormer walls	external air	0,2	0,24	0,25	0,25	0,13	0,25	0,215	0,32	-	0,32	[W/(m²K)]
cellar ceiling	cellar air or soil	0,4	0,4	0,4	0,4	0,3	0,4	0,4	0,4	-	0,4	[W/(m²K)]
floor to soil	cellar air or soil	0,4	0,4	0,4	0,4	0,3	0,4	0,4	0,4	-	0,4	[W/(m²K)]
walls to soil	cellar air or soil	0,4	0,4	0,4	0,4	0,3	0,4	0,4	0,4	-	0,4	[W/(m²K)]
walls to cellar	cellar air or soil	0,4	0,4	0,4	0,4	0,3	0,4	0,4	0,4	-	0,4	[W/(m²K)]
door to cellar	cellar air or soil	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	-	2,5	[W/(m²K)]
outside door	external air	2	2	2	2	2	2	2	2	-	2	[W/(m²K)]
windows	external air	1,25	1,35	1,35	1,35	0,8	1,35	0,95	1,5	-	1,5	[W/(m²K)]
Restricting limit		maximum primary energy demand	maximum primary energy demand	maximum heat transfer coefficient	maximum heat transfer coefficient	maximum primary energy demand	maximum primary energy demand	maximum primary energy demand	maximum heat transfer coefficient	maximum primary energy demand	maximum heat transfer coefficient	
Remarks												

Mean heat transmission losses (basis for cross country comparison)

Element	element area		heat transfer coefficient										
	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	
tilted roof	150,4	1	30,1	30,1	30,1	30,1	21,1	30,1	30,1	37,6	-	37,6	
flat roof	36,7	1	7,3	7,3	7,3	7,3	5,1	7,3	7,3	9,2	-	9,2	
dormer roof	7,5	1	1,5	1,5	1,5	1,5	1,1	1,5	1,5	1,9	-	1,9	
walls	454,4	1	109,1	109,1	113,6	113,6	59,1	113,6	97,7	145,4	-	145,4	
dormer walls	4,4	1	0,9	1,1	1,1	1,1	0,6	1,1	0,9	1,4	-	1,4	
cellar ceiling	173,5	0,6	41,6	41,6	41,6	41,6	31,2	41,6	41,6	41,6	-	41,6	
floor to soil	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	-	0,0	
walls to soil	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	-	0,0	
walls to cellar	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	-	0,0	
door to cellar	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	-	0,0	
outside door	2,1	1	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2	-	4,2	
windows	127,4	1	159,3	172,0	172,0	172,0	101,9	172,0	121,0	191,1	-	191,1	
sum	956,4		354	367	371	371	224	371	304	432	0	432	
Mean heat transmission losses per m² envelope			0,37	0,38	0,39	0,39	0,23	0,39	0,32	0,45	-	0,45	[W/(m²K)]

Applied method

Country	France
Region	Alsace (H1b)
Type of requirements / method used to proof the compliance	The used method is based on several steps:1) use the "reference" U values of each building fabric component to calculate the building overall Uvalue Ubat 2) make sure the result is lower than 1,2 x the "reference" Ubat 3) calculate the project consumption (C in kWh/m2 primary energy) and the reference consumption Cref 4) Check compliance in having C < Cref and C < Cepmax which is an absolute figure depending only on the energy and the location 5) depending on the result, iterate by modifying some Uvalues to comply with the "lowest" effort.
Requirements in force since	September 2006

Resulting U-values

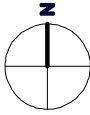
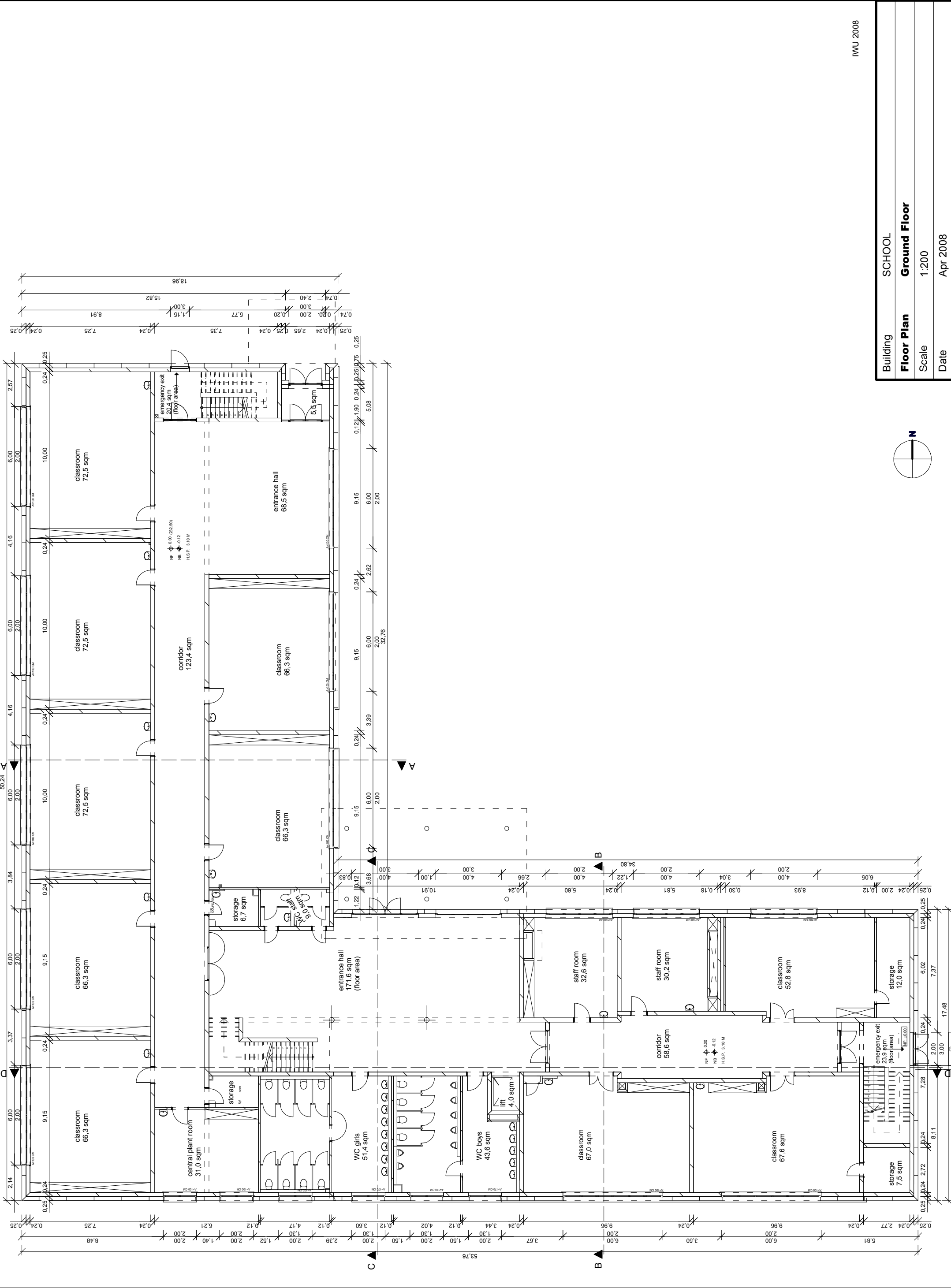
Model building N°		2										
Building type		apartment building										
Variant N°		2-0	2-11	2-12	2-13	2-21	2-22	2-31	2-32	2-41	2-42	
variant name		basis	hg-bnc	hg-pellet	hg-hp	dhw-el	dhw-sol	vent-nomec	vent-rec	sys-el	sys-sol/rec	
U-values		U-value defined for temperature difference between room and ...										
tilted roof	external air	0,2	0,2	0,2	0,2	0,15	0,2	0,2	0,2	0,15	0,2	[W/(m²K)]
flat roof	external air	0,27	0,2	0,2	0,27	0,15	0,27	0,2	0,27	0,15	0,3	[W/(m²K)]
dormer roof	external air	0,2	0,2	0,2	0,2	0,15	0,2	0,2	0,2	0,15	0,2	[W/(m²K)]
walls	external air	0,36	0,3	0,3	0,36	0,2	0,36	0,3	0,36	0,3	0,4	[W/(m²K)]
dormer walls	external air	0,36	0,3	0,3	0,36	0,2	0,36	0,3	0,36	0,3	0,4	[W/(m²K)]
cellar ceiling	cellar air or soil	0,27	0,2	0,2	0,27	0,15	0,27	0,2	0,27	0,2	0,27	[W/(m²K)]
floor to soil	cellar air or soil	0,27	0,2	0,2	0,27	0,15	0,27	0,2	0,27	0,2	0,27	[W/(m²K)]
walls to soil	cellar air or soil	0,2	0,2	0,2	0,2	0,15	0,2	0,2	0,2	0,2	0,2	[W/(m²K)]
walls to cellar	cellar air or soil	0,2	0,2	0,2	0,2	0,15	0,2	0,2	0,2	0,2	0,2	[W/(m²K)]
door to cellar	cellar air or soil	1,5	1,5	1,5	1,5	1	1,5	1,5	1,5	1,5	1,5	[W/(m²K)]
outside door	external air	1,5	1,5	1,5	1,5	1	1,5	1,5	1,5	1,5	1,5	[W/(m²K)]
windows	external air	1,8	1,6	1,6	1,8	1	1,8	1,6	1,8	1,4	2	[W/(m²K)]
Restricting limit		Cref	Cref	Cref	Cref	CepMax	Cref	Cref	Cref	Cref	Cref (+Ubatref)	
Remarks		reference Psi values for thermal briges				needs also special treatment of thermal bridging to get compliance						

Mean heat transmission losses (basis for cross country comparison)

Element	element area		heat transfer coefficient										
	[m²]	correction factor (only for cross-country comparison)	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	
tilted roof	150,4	1	30,1	30,1	30,1	30,1	22,6	30,1	30,1	30,1	22,6	30,1	
flat roof	36,7	1	9,9	7,3	7,3	9,9	5,5	9,9	7,3	9,9	5,5	11,0	
dormer roof	7,5	1	1,5	1,5	1,5	1,5	1,1	1,5	1,5	1,5	1,1	1,5	
walls	454,4	1	163,6	136,3	136,3	163,6	90,9	163,6	136,3	163,6	136,3	181,8	
dormer walls	4,4	1	1,6	1,3	1,3	1,6	0,9	1,6	1,3	1,6	1,3	1,8	
cellar ceiling	173,5	0,6	28,1	20,8	20,8	28,1	15,6	28,1	20,8	28,1	20,8	28,1	
floor to soil	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	
walls to soil	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	
walls to cellar	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	
door to cellar	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	
outside door	2,1	1	3,2	3,2	3,2	3,2	2,1	3,2	3,2	3,2	3,2	3,2	
windows	127,4	1	229,3	203,8	203,8	229,3	127,4	229,3	203,8	229,3	178,4	254,8	
sum	956,4		467	404	404	467	266	467	404	467	369	512	
Mean heat transmission losses per m² envelope			0,49	0,42	0,42	0,49	0,28	0,49	0,42	0,49	0,39	0,54	[W/(m²K)]

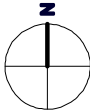
Appendix 3: Definition of Model Building 3 – school

Appendix 3a: Plans

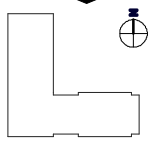


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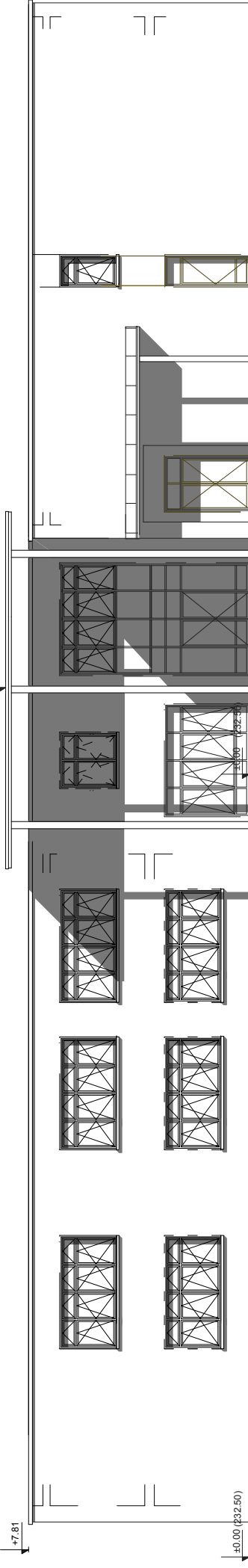
Building	SCHOOL
Floor Plan	Ground Floor
Scale	1:200
Date	Apr 2008



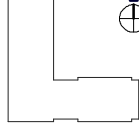
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Floor Plan	First Floor
Scale	1:200
Date	Apr 2008



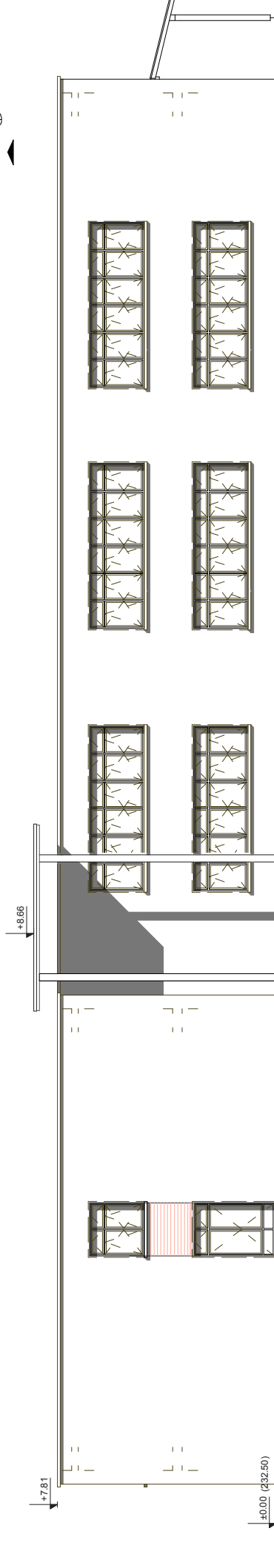
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Elevation North



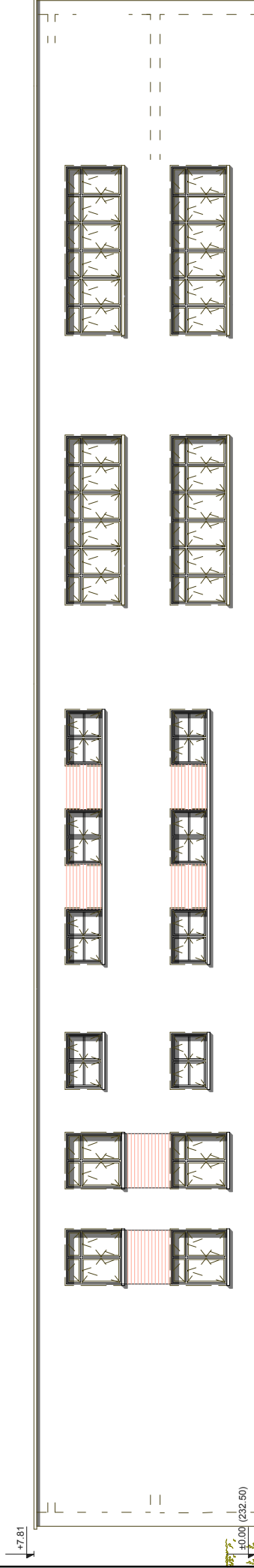
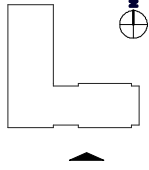
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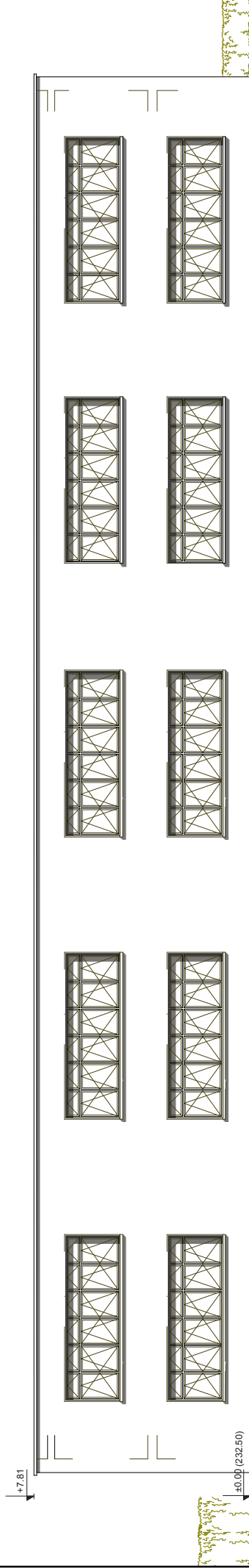
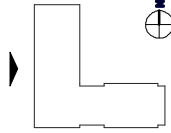
Elevation East

IWU 2008

Building	SCHOOL
Floor Plan	Elevations North, East
Scale	1:200
Date	Apr 2008



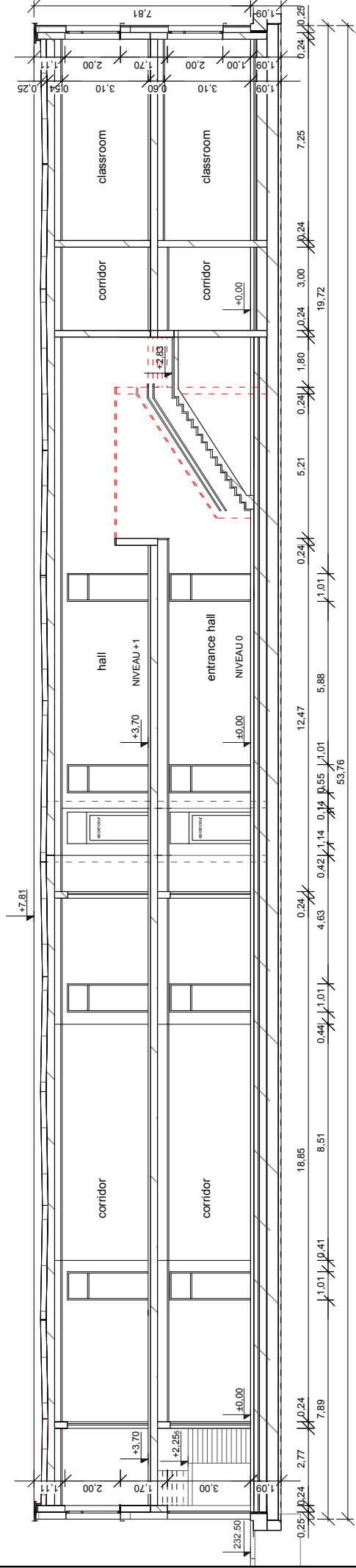
Elevation South



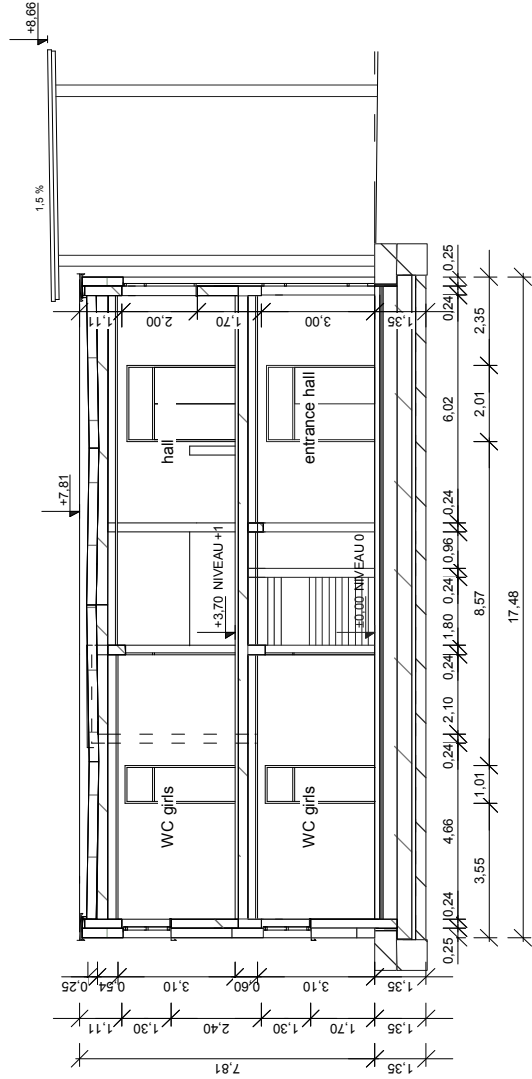
Elevation West

IWU 2008

Building	SCHOOL
Floor Plan	Elevations South, West
Scale	1:200
Date	Apr 2008



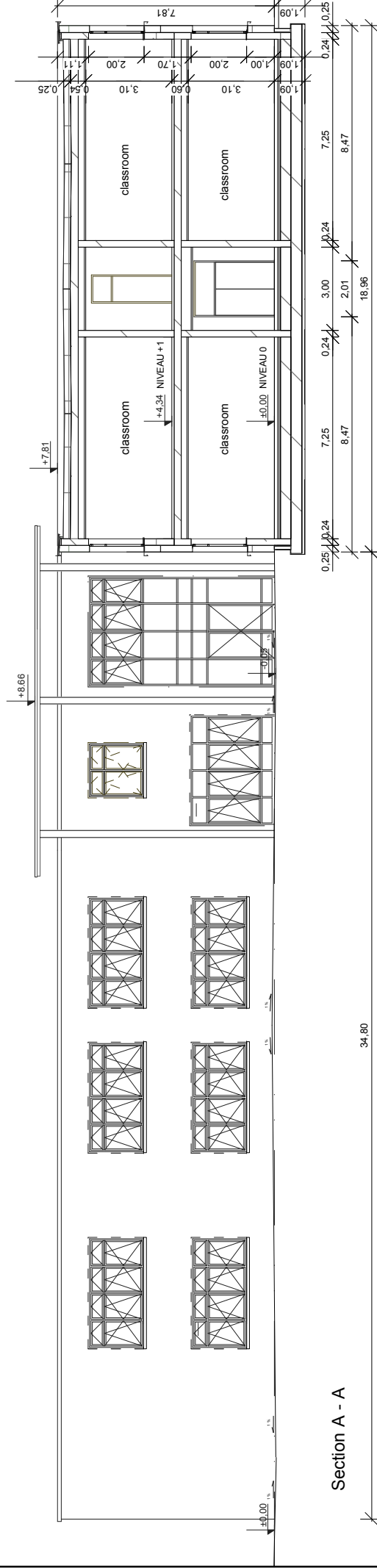
Section D - D



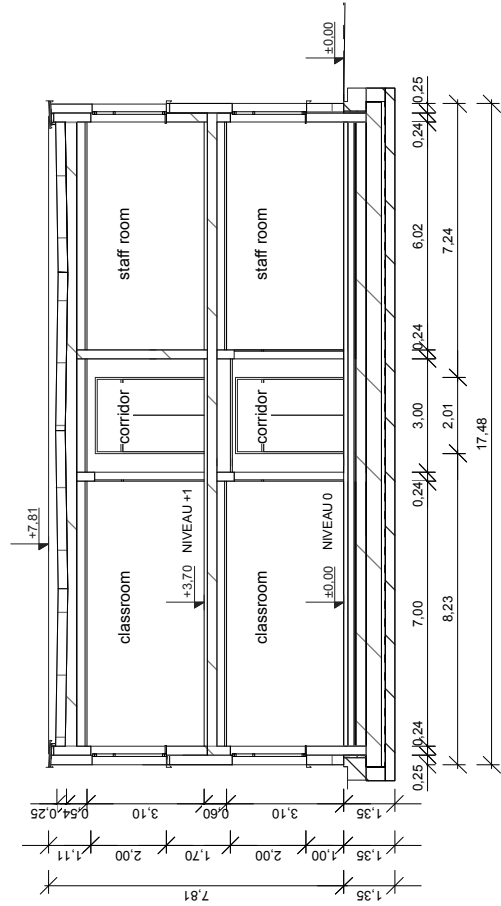
Section C - C

Building	SCHOOL
Floor Plan	Sections C - C, D - D
Scale	1:200
Date	Apr 2008

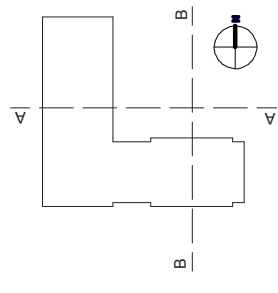
IWU 2008



Section A - A



Section B - B



IWU 2008

Building	SCHOOL
Floor Plan	Sections A - A, B - B
Scale	1:200
Date	Apr 2008

Appendix 3b: Detailed envelope area calculation (external dimensions)

name area element (free)	further specification / location	dedicated envelope area type	dedicated orientation for windows	reductio n area: insert "R"	width	length	height	number (if <> 1)	addition al area	gross surface area	net surface area	specific loss
					[m]	[m]	[m]		[m²]	[m²]	[m²]	[W/K]
1. floor 1	central and Eastern building partition	floor			17,48	53,76					939,7	0,0
2. floor 2	Northern building partition	floor			32,76	18,96					621,1	0,0
3. facade N1a	orientation North part. N, ground	wall to soil N				18,96	1,09				20,7	0,0
4. facade N1b	orientation North part. N, external air	wall N				18,96	7,81			148,1	136,3	0,0
5. door N1	orientation North part. N	door N		R		2,00	3,00				6,0	0,0
6. door N2	orientation North part. N	door N		R		1,15	3,00				3,5	0,0
7. window N1	orientation North part. N	window N	N	R		1,15	2,00				2,3	0,0
8. facade N2a	orientation North part. E, ground	wall to soil N				34,80	1,09				37,9	0,0
9. facade N2b	orientation North part. E, external air	wall N				34,80	7,81			271,8	187,8	0,0
10. door N3	orientation North part. E	door N		R		1,15	2,00				2,3	0,0
11. window N2	orientation North part. E, ground floor	window N	N	R		4,00	3,00		-2,30		9,7	0,0
12. window N3	orientation North part. E, first floor	window N	N	R		4,00	2,00				8,0	0,0
13. window N4	orientation North part. E, ground floor	window N	N	R		4,00	3,00				12,0	0,0
14. window N5	orientation North part. E, first floor	window N	N	R		2,00	2,00				4,0	0,0
15. window N6	orientation North part. E	window N	N	R		4,00	2,00	6			48,0	0,0
16. facade E1a	orientation East part. N, ground	wall to soil E				32,76	1,09				35,7	0,0
17. facade E1b	orientation East part. N, external air	wall E				32,76	7,81			255,9	183,9	0,0
18. window E1	orientation East part. N	window E	E	R		6,00	2,00	6			72,0	0,0
19. facade E2a	orientation East part. E, ground	wall to soil E				17,48	1,09				19,1	0,0
20. facade E2b	orientation East part. E, external air	wall E				17,48	7,81			136,5	126,5	0,0
21. door E1	orientation East part. E	door E		R		2,00	3,00				6,0	0,0
22. window E2	orientation East part. E	window E	E	R		2,00	2,00				4,0	0,0
23. facade S1a	orientation South ground	wall to soil S				53,76	1,09				58,6	0,0
24. facade S1b	orientation South external air	wall S				53,76	7,81			419,9	335,1	0,0
25. window S1	orientation South	window S	S	R		6,00	2,00	4			48,0	0,0
26. window S2	orientation South	window S	S	R		2,00	1,30	8			20,8	0,0
27. window S3	orientation South	window S	S	R		2,00	2,00	4			16,0	0,0
28. facade W1a	orientation West part. N, ground	wall to soil W				50,24	1,09				54,8	0,0
29. facade W1b	orientation West part. N, external air	wall W				50,24	7,81			392,4	272,4	0,0
30. window W1	orientation West	window W	W	R		6,00	2,00	10			120,0	0,0
31. roof 1	central and Eastern building partition	roof			17,48	53,76					939,7	0,0
32. roof 2	Northern building partition	roof			32,76	18,96					621,1	0,0
33.											0,0	0,0
34.											0,0	0,0
35.											0,0	0,0
36.											0,0	0,0
37.											0,0	0,0
38.											0,0	0,0
39.											0,0	0,0
40.											0,0	0,0
Gesamt thermische Hülle:											4972,9	0,0

Appendix 3c: Definition of the supply system types

Explanation of table colours:

green = basic definition of the system

blue = to be used only if necessary; if not compatible to the national definitions or values the most similar ones were to be used

variant

variant N°

variant name

variant type

description

building

thermal envelope

- envelope surface area
- thermal bridges
- air-tightness

sunblinds / shading system

type
control

solar gains

- total solar energy transmittance (for radiation perpendicular to the glazing)
- correction factor to account for the proportion of the frames
- external shading correction factor (all directions)
 - alternatively: partial shading correction factor and respective angle
 - for the horizon (by other buildings, topography)
 - for overhangs (e. g. canopies, balconies etc.) above the component being shaded
 - partial shading correction factor for lateral building protrusions (fins)

heating system

heat generation (heating)

type

energy carrier

location

control temperature

further specification

thermal power

heat distribution (heating)

type
location
control temperature
electric consumption pump

heating pipes (if detailed input required)

string 1
pipe length
insulation thickness
alternatively: U-value

string 2
pipe length
insulation thickness
alternatively: U-value

string 3
pipe length
insulation thickness
alternatively: U-value

heat emission (heating)

type
control

3-0 basis	3-1 hq-bnc	3-2 hq-pellet	3-3 hq-hp	3-4 vent-nomec
variation heat generator	variation heat generator	variation heat generator	variation heat generator	variation ventilation
condensing boiler for heating and hot water + exhaust ventilation system	low temperature boiler (non-condensing)	wood pellet boiler	electric heat pump	no mechanical ventilation system
definition see plans (+ table with outside envelope areas, if applicable)				
no relevant constructive thermal bridges				
blower door measurement: $n_{50} \leq 1,5 \text{ h}^{-1}$	blower door measurement: $n_{50} \leq 1,5 \text{ h}^{-1}$	blower door measurement: $n_{50} \leq 1,5 \text{ h}^{-1}$	blower door measurement: $n_{50} \leq 1,5 \text{ h}^{-1}$	no blower door measurement
external, white, 45° inclination				
manual				
		0,6		
		0,7		
		0,9		
		0,9 (10°)		
		1,0 (0°)		
		1,0 (0°)		
condensing boiler	low temperature boiler (not condensing)	pellet boiler	electric heat pump (soil/water)	= var. 3-0
natural gas	natural gas	wood pellets	electricity	= var. 3-0
central plant room (inside the thermal envelope)	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
adjusted in dependence of outdoor temperature	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
maximum values for supply / return temperature: 70°C / 55°C	= var. 3-0	= var. 3-0	maximum values for supply / return temperature: 55°C / 45°C	= var. 3-0
166 kW	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
water pipes	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
all ducts inside the thermal envelope	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
control of heat distribution temperature according to outdoor air temperature	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
electric power = 225 W / running time = 9 h/d x 200 d/a	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
main string / horizontal	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
2 pipes x 113 m	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
20 mm	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
0,20 W/(m²K)	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
main string / vertical	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
2 pipes x 142 m	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
10 mm	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
0,26 W/(m²K)	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
distribution in rooms	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
2 pipes x 842 m	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
10 mm	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
0,26 W/(m²K)	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
radiators	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
thermostatic valves (regulation range: 2K)	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0

variant

variant N°
variant name
variant type

description

hot water system**heat demand hot water**

utilisation type

net heat demand

heat generation

type

energy carrier

location

further specification

heat storage
type

location

volume

heat loss per day

electric power storage load pump

heat distribution

type

location

temperature

electric consumption pump

heating pipes (if detailed input required)**string 1**

pipe length

insulation thickness
alternatively: U-value

string 2

pipe length

insulation thickness
alternatively: U-value

string 3

pipe length

insulation thickness
alternatively: U-value

ventilation system

type

heat recovery fraction

type control

mechanical air flow rate

electric consumption fans

specific fan power

total pressure difference

heat recovery system

minimum supply air temperature

humidification

dehumidification

cooling

lighting

type lamp

ballast

control

type of lighting

maintained illuminance

luminous efficiency of the light source + ballast

efficiency of luminaire

electric power (design value)

electric power (maintained value)

3-0	3-1	3-2	3-3	3-4
basis	hq-bnc	hq-pellet	hq-hp	vent-nomec
basis	variation heat generator	variation heat generator	variation heat generator	variation ventilation
condensing boiler for heating and hot water + exhaust ventilation system	low temperature boiler (non-condensing)	wood pellet boiler	electric heat pump	no mechanical ventilation system
hot water for WC / no showers	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
0,085 kWh/d x 200 d/a = 17kWh/(m²a)	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
combined with heat generator for space heating (see above)	combined with heat generator for space heating (see above)	combined with heat generator for space heating (see above)	combined with heat generator for space heating (see above)	= var. 3-0
(see above)	(see above)	(see above)	(see above)	= var. 3-0
(see above)	(see above)	(see above)	(see above)	= var. 3-0
-	-	-	-	= var. 3-0
hot water storage	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
central plant room (inside the thermal envelope)	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
749 liter	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
4,07 kWh/d	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
73 W	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
hot water circulation	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
completely inside of the thermal envelope	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
60°C	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
226 W x 9 h/d x 200 d/a	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
main string / horizontal	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
2 pipes x 6 m	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
20 mm	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
0.20 W/(m²K)	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
main string / vertical	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
2 pipes x 72 m	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
10 mm	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
0.26 W/(m²K)	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
distribution to taps in WCs	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
1 pipe x 22 m	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
10 mm	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
0.26 W/(m²K)	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
supply/exhaust ventilation system with heat recovery	= var. 3-0	= var. 3-0	= var. 3-0	none
75%	= var. 3-0	= var. 3-0	= var. 3-0	-
constant volume	= var. 3-0	= var. 3-0	= var. 3-0	-
10 m³/h/m² x 2724.9 m² = 27249 m³/h	= var. 3-0	= var. 3-0	= var. 3-0	-
21.5 kW x 9 h/d x 200 d/a	= var. 3-0	= var. 3-0	= var. 3-0	-
0.79 W/(m³/h)	= var. 3-0	= var. 3-0	= var. 3-0	-
supply: 960 Pa exhaust: 750 Pa	= var. 3-0	= var. 3-0	= var. 3-0	-
integrated fluid circulation system, 75% heat recovery	= var. 3-0	= var. 3-0	= var. 3-0	-
18°C	= var. 3-0	= var. 3-0	= var. 3-0	-
none	= var. 3-0	= var. 3-0	= var. 3-0	-
none	= var. 3-0	= var. 3-0	= var. 3-0	-
none	= var. 3-0	= var. 3-0	= var. 3-0	-
fluorescent tubes	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
low loss	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
manual	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
direct	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
300 lx	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
80 lm/W	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
80%	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
9.6 W/m² x 2724.9 m² = 26.16 kW	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
6.4 W/m² x 2724.9 m² = 17.4 kW	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0

Appendix 3d: Country sheets

Applied method

Country	Germany
Region	whole country
Type of requirements / method used to proof the compliance	<p>Requirements to be complied:</p> <ul style="list-style-type: none"> - maximum values for thermal transmittance - primary energy demand for heating, hot water, ventilation, cooling/air-conditioning, lighting <p>The maximum primary energy demand is determined by means of a reference building.</p> <p>Calculation according to the German Energy Saving Ordinance (Energieeinsparverordnung EnEV 2007) simplified procedure for non-residential buildings / one-zone model calculation according to DIN V 18599</p>
Requirements in force since	October 2007

Resulting U-values

Model building N°		3					
Building type		school					
Variant N°		3-0	3-1	3-2	3-3	3-4	
variant name		basis	hg-bnc	hg-pellet	hg-hp	vent-nomec	
U-values		U-value defined for temperature difference between room and ...					
roof	external air	0,56	0,56	0,56	0,56	0,52	[W/(m²K)]
wall	external air	0,9	0,8	0,9	0,9	0,7	[W/(m²K)]
wall to soil	soil	0,9	0,8	0,9	0,9	0,7	[W/(m²K)]
windows	external air	2,0	2,0	2,0	2,0	1,5	[W/(m²K)]
doors	external air	3,0	3,0	3,0	3,0	2,0	[W/(m²K)]
floor	soil	0,9	0,9	0,9	0,9	0,7	[W/(m²K)]
Restricting limit		maximum heat transfer coefficient	primary energy demand and primary energy demand	maximum heat transfer coefficient	maximum heat transfer coefficient	primary energy demand	
Remarks							

Mean heat transmission losses (basis for cross country comparison)

element area		correction factor (only for cross-country comparison)	heat transfer coefficient				
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
roof	1560,9	1	874,1	874,1	874,1	874,1	811,7
wall	1242	1	1117,8	993,6	1117,8	1117,8	869,4
wall to soil	226,8	0,6	122,5	108,9	122,5	122,5	95,3
windows	364,8	1	729,6	729,6	729,6	729,6	547,2
doors	17,8	1	53,4	53,4	53,4	53,4	35,6
floor	1560,9	0,35	491,7	491,7	491,7	491,7	382,4
sum	4973,2		3389	3251	3389	3389	2742
Mean heat transmission losses per m² envelope (not considering thermal bridges)			0,68	0,65	0,68	0,68	0,55
			[W/(m²K)]				

Applied method

Country	Austria
Region	whole country
Type of requirements / method used to proof the compliance	In Austria the relevant regulation for the heating demand is the net energy demand for heating per m³ depending on the proportion of building volume to building surface ($l_c = V/A$). Additionally to the heating demand service buildings (e.g. schools) have to fulfill a regulation for the externally induced cooling demand per m³. The requirements are regulated in the OIB directive 6 "Energieeinsparung und Wärmeschutz" from April 2007 and are calculated with a reference climate with 3.400 degree days. The calculation method is defined in the Austrian Standard ÖNORM B 8110-6, which is based on the ISO EN 13790. Main estimations, which were not provided: "heavy construction" (brick or concrete). In Austria, the heating system has no influence on the U-Values. The current requirement (until 31.12.2009): $HWB = 9 * (1 + 2/l_c)$ kWh/m³a. The data of the model building: $l_c = 2,79$ m; $HWB < 15,4$ kWh/m³a.
Requirements in force since	April 2007

Resulting U-values

Model building N° Building type		3					
		school					
Variant N° variant name		3-0	3-1	3-2	3-3	3-4	
		basis	hg-bnc	hg-pellet	hg-hp	vent-nomec	
U-values		U-value defined for temperature difference between room and ...					
roof	external air	0,2	0,2	0,2	0,2	0,2	[W/(m²K)]
wall	external air	0,35	0,35	0,35	0,35	0,35	[W/(m²K)]
wall to soil	soil	0,4	0,4	0,4	0,4	0,4	[W/(m²K)]
windows	external air	1,4	1,4	1,4	1,4	1,4	[W/(m²K)]
doors	external air	1,7	1,7	1,7	1,7	1,7	[W/(m²K)]
floor	soil	0,4	0,4	0,4	0,4	0,4	[W/(m²K)]
Restricting limit		net energy demand for heating	net energy demand for heating	net energy demand for heating	net energy demand for heating	net energy demand for heating	
Remarks		Above specified U-values are the minimum standards for each single component regulated in the OIB directive 6. The requirement for heating and cooling demand will be achieved by using the minimum standard of U-values.	Above specified U-values are the minimum standards for each single component regulated in the OIB directive 6. The requirement for heating and cooling demand will be achieved by using the minimum standard of U-values.	Above specified U-values are the minimum standards for each single component regulated in the OIB directive 6. The requirement for heating and cooling demand will be achieved by using the minimum standard of U-values.	Above specified U-values are the minimum standards for each single component regulated in the OIB directive 6. The requirement for heating and cooling demand will be achieved by using the minimum standard of U-values.	Above specified U-values are the minimum standards for each single component regulated in the OIB directive 6. The requirement for heating and cooling demand will be achieved by using the minimum standard of U-values.	

Mean heat transmission losses (basis for cross country comparison)

element area		correction factor (only for cross-country comparison)	heat transfer coefficient					
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	
roof	1560,9	1	312,2	312,2	312,2	312,2	312,2	
wall	1242	1	434,7	434,7	434,7	434,7	434,7	
wall to soil	226,8	0,6	54,4	54,4	54,4	54,4	54,4	
windows	364,8	1	510,7	510,7	510,7	510,7	510,7	
doors	17,8	1	30,3	30,3	30,3	30,3	30,3	
floor	1560,9	0,35	218,5	218,5	218,5	218,5	218,5	
sum	4973,2		1561	1561	1561	1561	1561	
Mean heat transmission losses per m² envelope (not considering thermal bridges)			0,31	0,31	0,31	0,31	0,31	[W/(m²K)]

Applied method

Country
Region

Czech Republic
whole country

Type of requirements /
method used to proof the compliance

Calculation method according to the requirements of the Act no. 406/2000 Coll. on Energy Management, its amendment no. 177/2006 Coll. as amended by no. 406/2006 Coll. and the Code of Practice no. 148/2007 Coll. on Energy Demand of Buildings as amended. A specific technical regulation in this field is the Czech standard ČSN 73 0540 "Thermal Protection of Buildings" (and a set of relevant standards), which the abovementioned statutes are related to and make its requirements binding. Valid requirements for U values are set forth in the second part of the standard i.e. in ČSN 73 0540-2 as of April 2007. Two groups of U values are prescribed: recommended values and required values. Required U-values were used in this table. According to the Czech regulations for the new buildings the maximum U-values as mandatory values do not depend on the energy efficiency of the heat supply system or of the lighting system.

Requirements in force since

April 2007

Resulting U-values

Model building N°
Building type

3

school

Variant N°

variant name

3-0

3-1

3-2

3-3

3-4

basis

hg-bnc

hg-pellet

hg-hp

vent-nomec

U-values

U-value defined for
temperature difference
between room and ...

roof

external air

0,24

0,24

0,24

0,24

0,24

[W/(m²K)]

wall

external air

0,3

0,3

0,3

0,3

0,3

[W/(m²K)]

wall to soil

soil

0,45

0,45

0,45

0,45

0,45

[W/(m²K)]

windows

external air

1,7

1,7

1,7

1,7

1,7

[W/(m²K)]

doors

external air

1,7

1,7

1,7

1,7

1,7

[W/(m²K)]

floor

soil

0,45

0,45

0,45

0,45

0,45

[W/(m²K)]

Restricting limit

U-Values

U-Values

U-Values

U-Values

U-Values

Remarks

Mean heat transmission losses (basis for cross country comparison)

Element	element area		heat transfer coefficient				
	[m²]	correction factor (only for cross-country comparison)	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
roof	1560,9	1	374,6	374,6	374,6	374,6	374,6
wall	1242	1	372,6	372,6	372,6	372,6	372,6
wall to soil	226,8	0,6	61,2	61,2	61,2	61,2	61,2
windows	364,8	1	620,2	620,2	620,2	620,2	620,2
doors	17,8	1	30,3	30,3	30,3	30,3	30,3
floor	1560,9	0,35	245,8	245,8	245,8	245,8	245,8
sum	4973,2		1705	1705	1705	1705	1705
Mean heat transmission losses per m² envelope (not considering thermal bridges)			0,34	0,34	0,34	0,34	0,34

[W/(m²K)]

Applied method

Country	Poland
Region	whole country
Type of requirements / method used to proof the compliance	The calculation based on just accepted methodology for building performance calculation. It base on hourly climatic data and used asset rating methodology. Additional some requirements related to building thermal condition are updated and presented in "Ordinance about technical condition to be fulfilled by the buildings and theirs surroundings". In Poland max U values depend only on the building type (for windows also on location in climatic zone), and are independed from the heating system. According to the Polish methodology thermal envelope size is calculateddd on external dimensions.
Requirements in force since	October 2002

Resulting U-values

Model building N°	3					
Building type	school					
Variant N°	3-0	3-1	3-2	3-3	3-4	
variant name	basis	hg-bnc	hg-pellet	hg-hp	vent-nomec	
U-values	U-value defined for temperature difference between room and ...					
roof	external air	0,5	0,5	0,5	0,5	[W/(m²K)]
wall	external air	0,55	0,55	0,55	0,55	[W/(m²K)]
wall to soil	soil	0,7	0,7	0,7	0,7	[W/(m²K)]
windows	external air	2,6	2,6	2,6	2,6	[W/(m²K)]
doors	external air	2,6	2,6	2,6	2,6	[W/(m²K)]
floor	soil	0,6	0,6	0,6	0,6	[W/(m²K)]
Restricting limit	U-values	U-values	U-values	U-values	U-values	
Remarks	max. U-value of windows depending on climate: 2.3 or 2.6 W/(m²K)	max. U-value of windows depending on climate: 2.3 or 2.6 W/(m²K)	max. U-value of windows depending on climate: 2.3 or 2.6 W/(m²K)	max. U-value of windows depending on climate: 2.3 or 2.6 W/(m²K)	max. U-value of windows depending on climate: 2.3 or 2.6 W/(m²K)	

Mean heat transmission losses (basis for cross country comparison)

element	area	correction factor (only for cross-country comparison)	heat transfer coefficient				
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
roof	1560,9	1	780,5	780,5	780,5	780,5	780,5
wall	1242	1	683,1	683,1	683,1	683,1	683,1
wall to soil	226,8	0,6	95,3	95,3	95,3	95,3	95,3
windows	364,8	1	948,5	948,5	948,5	948,5	948,5
doors	17,8	1	46,3	46,3	46,3	46,3	46,3
floor	1560,9	0,35	327,8	327,8	327,8	327,8	327,8
sum	4973,2		2881	2881	2881	2881	2881
Mean heat transmission losses per m² envelope (not considering thermal bridges)			0,58	0,58	0,58	0,58	0,58 [W/(m²K)]

Applied method

Country	Sweden
Region	whole country
Type of requirements / method used to proof the compliance	<p>From the Swedish regulation for building (Regelsamling för byggande - Boverkets byggregler, BBR 15, 2008)</p> <p>Premises will be formulated so that the building's specific energy use highest amounts to 100 kWh per m2 floor area (Atemp) and years in climate zone south and 120 kWh per m2 floor area (Atemp) and years in climate zone north. For premises with ventilation over 0,35 l/s, m2 gets an addition to be done corresponding 70 (q-0,35) kWh per m2 floor area (Atemp) and years in climate zone south and 90 (q-0,35) kWh per m2 floor area (Atemp) and years in climate zone north, there q is it average ventilation during the entire heating season (l/s, m2). (BFS 2006:12).</p> <p>General councils</p> <p>In the building's specific energy use does not be included activity electrical. (BFS 2006:12).</p>
Requirements in force since	2008

Resulting U-values

Model building N°		3					
Building type		school					
Variant N°		3-0	3-1	3-2	3-3	3-4	
variant name		basis	hg-bnc	hg-pellet	hg-hp	vent-nomec	
U-values		U-value defined for temperature difference between room and ...					
roof	external air	-	-	-	0,15	-	[W/(m²K)]
wall	external air	-	-	-	0,15	-	[W/(m²K)]
wall to soil	soil	-	-	-	0,12	-	[W/(m²K)]
windows	external air	-	-	-	1,2	-	[W/(m²K)]
doors	external air	-	-	-	1,0	-	[W/(m²K)]
floor	soil	-	-	-	0,12	-	[W/(m²K)]
Restricting limit		Maximum specific energy consumption 166 kWh/m2 floor area, with ventilation 1,5 ac/h	-	Maximum specific energy consumption 166 kWh/m2 floor area, with ventilation 1,5 ac/h	Maximum specific energy consumption 166 kWh/m2 floor area, with ventilation 1,5 ac/h	-	
Remarks		Difficult to meet the requirements without heat pump. Result 175 kWh/m2 floor area - more than restricting limit 166 kWh/m2. Wall to soil included in floor	not possible to meet the requirements	Difficult to meet the requirements without heat pump. Result 208 kWh/m2 floor area - more than restricting limit 166 kWh/m2. Wall to soil included in floor	Result 160 kWh/m2 floor area - less than restricting limit 166 kWh/m2. Wall to soil included in floor	not possible to meet the requirements	

Mean heat transmission losses (basis for cross country comparison)

element area		correction factor (only for cross-country comparison)	heat transfer coefficient				
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
roof	1560,9	1	-	-	-	234,1	-
wall	1242	1	-	-	-	186,3	-
wall to soil	226,8	0,6	-	-	-	16,3	-
windows	364,8	1	-	-	-	437,8	-
doors	17,8	1	-	-	-	17,8	-
floor	1560,9	0,35	-	-	-	65,6	-
sum	4973,2		0	0	0	958	0
Mean heat transmission losses per m² envelope (not considering thermal bridges)			-	-	-	0,19	-
			[W/(m²K)]				

Applied method

Country
Region

Denmark
whole country

Type of requirements /
method used to proof the compliance

Monthly calculation according to the SBI direction 213, Calculation of buildings energy demand.
- heating demand is based on prEN ISO 13790:2005, which elaborates on EN 832 and EN ISO 13790.
- cooling demand is based on prEN ISO 13790:2005.
- heat loss from installations is calculated as defined in prEN 15316 part 2.3 og part 3.2.
- boilers is calculated according to prEN 15316 part 4.1 methode II and part 3.3.
- calculation tool: Be06, version 4,8,7,12

Requirements to be complied: maximum primary energy demand, maximum values for overall thermal transmittance and maximum U-values for constructions.

This new building must have an energy consumption less than 95+2200/A, having a dimensioning transmission losses less than 7 W/m² (two storey) through the thermal envelope or meet maximum U-values for the constructions.

Requirements in force since

January 2006

Resulting U-values

Model building N°
Building type

3
school

Variant N°

variant name

3-0

3-1

3-2

3-3

3-4

basis

hg-bnc

hg-pellet

hg-hp

vent-nomec

U-values

U-value defined for
temperature difference
between room and ...

roof

external air

0,12

-

0,11

0,2

0,16

[W/(m²K)]

wall

external air

0,16

-

0,12

0,22

0,18

[W/(m²K)]

wall to soil

soil

0,2

-

0,15

0,25

0,25

[W/(m²K)]

windows

external air

1,2

-

1,0

1,3

1,25

[W/(m²K)]

doors

external air

1,2

-

1,2

1,2

1,2

[W/(m²K)]

floor

soil

0,2

-

0,15

0,2

0,25

[W/(m²K)]

Restricting limit

Energy frame plus
goodwill (6,7
kWh/m² per. year)
for ventilation above
1,2 l/(s m²) = 102,4
kWh/m² per. year .

Non condenssing
boiler is illegal in new
Danish buildings!

Energy frame plus
goodwill (6,7
kWh/m² per. year)
for ventilation above
1,2 l/(s m²) = 102,4
kWh/m² per. year .

Energy frame plus
goodwill (6,7
kWh/m² per. year)
for ventilation above
1,2 l/(s m²) = 102,4
kWh/m² per. year .

Energy frame = 95,7 kWh/m²
per. year.

Remarks

Efficiency at full load
92.3 % and at part
load (20%) 89.3 %

COP = 3 (full load)
2.7 (50 % load)

Mean heat transmission losses (basis for cross country comparison)

Element	element area		heat transfer coefficient				
	[m ²]	correction factor (only for cross-country comparison)	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
roof	1560,9	1	187,3	-	171,7	312,2	249,7
wall	1242	1	198,7	-	149,0	273,2	223,6
wall to soil	226,8	0,6	27,2	-	20,4	34,0	34,0
windows	364,8	1	437,8	-	364,8	474,2	456,0
doors	17,8	1	21,4	-	21,4	21,4	21,4
floor	1560,9	0,35	109,3	-	81,9	109,3	136,6
sum	4973,2		982	0	809	1224	1121
Mean heat transmission losses per m ² envelope (not considering thermal bridges)			0,20	-	0,16	0,25	0,23

[W/(m²K)]

Applied method

Country	UK
Region	England & Wales
Type of requirements / method used to proof the compliance	The calculation is based on the methodology that calculates monthly energy use and carbon dioxide emissions of a building given a description of the building geometry, construction, use and HVAC and lighting equipment. It was originally based on the Dutch methodology NEN 2916:1998 (Energy Performance of Non-Residential Buildings) and has since been modified to comply with the emerging CEN Standards. According to UK building regulation 2006, the maximum building fabric U - values are calculated to fulfil the requirement.
Requirements in force since	April 2006

Resulting U-values

Model building N°	3					
Building type	school					
Variant N°	3-0	3-1	3-2	3-3	3-4	
variant name	basis	hg-bnc	hg-pellet	hg-hp	vent-nomec	
U-values	U-value defined for temperature difference between room and ...					
roof	external air	0,12	0,1	0,25	0,25	0,25 [W/(m²K)]
wall	external air	0,2	0,15	0,35	0,35	0,35 [W/(m²K)]
wall to soil	soil	0,2	0,15	0,35	0,35	0,35 [W/(m²K)]
windows	external air	1,0	1,2	1,99	1,99	1,99 [W/(m²K)]
doors	external air	0,7	0,7	0,7	0,7	0,7 [W/(m²K)]
floor	soil	0,12	0,1	0,25	0,25	0,25 [W/(m²K)]
Restricting limit	maximum CO2 emissions	maximum CO2 emissions	maximum U-values of elements	maximum U-values of elements	maximum U-values of elements	
Remarks						

Mean heat transmission losses (basis for cross country comparison)

element area		correction factor (only for cross-country comparison)	heat transfer coefficient					
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	
roof	1560,9	1	187,3	156,1	390,2	390,2	390,2	
wall	1242	1	248,4	186,3	434,7	434,7	434,7	
wall to soil	226,8	0,6	27,2	20,4	47,6	47,6	47,6	
windows	364,8	1	364,8	437,8	726,0	726,0	726,0	
doors	17,8	1	12,5	12,5	12,5	12,5	12,5	
floor	1560,9	0,35	65,6	54,6	136,6	136,6	136,6	
sum	4973,2		906	868	1748	1748		
Mean heat transmission losses per m² envelope (not considering thermal bridges)			0,18	0,17	0,35	0,35	0,35	[W/(m²K)]

Applied method

Country	Netherlands
Region	whole country
Type of requirements / method used to proof the compliance	<p>Energy use calculations:</p> <ul style="list-style-type: none"> * Dutch Standard NEN 2916: Energy performance of non-residential buildings - Determination method (NNI, March 2004). * EPU for Windows Version 2.0 (NNI, 2006) <p>Requirements to be met:</p> <ul style="list-style-type: none"> * $EPC \leq 1,4$ (EPC = Energy Performance Coefficient, based on primary energy demand), and * Minimum R_c values (heat resistance) for thermal envelope ($R_c \geq 2,5 \text{ m}^2\text{K/W}$)
Requirements in force since	2003 ($EPC \leq 1,4$), 1992 ($R_c \geq 2,5 \text{ W/m}^2\text{K}$)

Resulting U-values

Model building N°		3					
Building type		school					
Variant N°		3-0	3-1	3-2	3-3	3-4	
variant name		basis	hg-bnc	hg-pellet	hg-hp	vent-nomec	
U-values		U-value defined for temperature difference between room and ...					
roof	external air	0,1	-	-	0,37	0,12	[W/(m²K)]
wall	external air	0,1	-	-	0,37	0,12	[W/(m²K)]
wall to soil	soil	0,1	-	-	0,37	0,12	[W/(m²K)]
windows	external air	1,3	-	-	1,8	1,3	[W/(m²K)]
doors	external air	2,0	-	-	2,0	2,0	[W/(m²K)]
floor	soil	0,1	-	-	0,37	0,12	[W/(m²K)]
Restricting limit		EPC <=1,4	Required Rc = 75,0 in order to meet restrictions	Not achievable	EPC <=1,4	EPC <=1,4	
Remarks		Difficult to meet the requirements. Ventilation and fan energy are high, beause no fan control is applied (constant volume). The running hours are fixed (based on function).	Non condensing boiler is not sufficient.	Wood pellet boiler is not a standard option in the calculation method and should be considered as "other heating system", which has a relatively low efficiency		Infiltration rate is assumed to be the same as in the other calculations.	

Mean heat transmission losses (basis for cross country comparison)

element area		correction factor (only for cross-country comparison)	heat transfer coefficient					
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	
roof	1560,9	1	156,1	-	-	577,5	187,3	
wall	1242	1	124,2	-	-	459,5	149,0	
wall to soil	226,8	0,6	13,6	-	-	50,3	16,3	
windows	364,8	1	474,2	-	-	656,6	474,2	
doors	17,8	1	35,6	-	-	35,6	35,6	
floor	1560,9	0,35	54,6	-	-	202,1	65,6	
sum	4973,2		858	0	0	1982	928	
Mean heat transmission losses per m² envelope (not considering thermal bridges)			0,17	-	-	0,40	0,19	[W/(m²K)]

Applied method

Country	Belgium
Region	Flanders
Type of requirements / method used to proof the compliance	Method described in the decree of the 5th of march 2005. Three requirements are imposed: one limits the characteristic annual primary energy consumption for the building, a second one limits the average thermal transmittance for the whole building, and a third one gives the maximal values of the thermal transmittance of each component.
Requirements in force since	January 2007

Resulting U-values

Model building N°		3					
Building type		school					
Variant N°		3-0	3-1	3-2	3-3	3-4	
variant name		basis	hg-bnc	hg-pellet	hg-hp	vent-nomec	
U-values		U-value defined for temperature difference between room and ...					
roof	external air	0,4	0,4	0,4	0,4	0,4	[W/(m²K)]
wall	external air	0,6	0,6	0,6	0,6	0,6	[W/(m²K)]
wall to soil	external air	0,6	0,6	0,6	0,6	0,6	[W/(m²K)]
windows	external air	2,5	2,5	2,5	2,5	2,5	[W/(m²K)]
doors	external air	2,9	2,9	2,9	2,9	2,9	[W/(m²K)]
floor	external air	0,4	0,4	0,4	0,4	0,4	[W/(m²K)]
Restricting limit		Maximal values of the thermal transmittance coefficients	Maximal values of the thermal transmittance coefficients	Maximal values of the thermal transmittance coefficients	Maximal values of the thermal transmittance coefficients	Maximal values of the thermal transmittance coefficients	
Remarks							

Mean heat transmission losses (basis for cross country comparison)

element area		correction factor (only for cross-country comparison)	heat transfer coefficient					
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	
roof	1560,9	1	624,4	624,4	624,4	624,4	624,4	
wall	1242	1	745,2	745,2	745,2	745,2	745,2	
wall to soil	226,8	1	136,1	136,1	136,1	136,1	136,1	
windows	364,8	1	912,0	912,0	912,0	912,0	912,0	
doors	17,8	1	51,6	51,6	51,6	51,6	51,6	
floor	1560,9	1	624,4	624,4	624,4	624,4	624,4	
sum	4973,2		3094	3094	3094	3094	3094	
Mean heat transmission losses per m² envelope (not considering thermal bridges)			0,62	0,62	0,62	0,62	0,62	[W/(m²K)]

Applied method

Country	Luxembourg
Region	whole country
Type of requirements / method used to proof the compliance	<p>According to the "Règlement grand-ducal du 22 November 1995" there are only requirements for the mean U-value. The system parameters (heating, ventilation, ...) are not considered. In addition the calculated U-Values fulfill the target mean U-value demanded by the « Commodo-Incommodo procedure » (environmental procedure) which is normally applied to school buildings.</p> <p>The new calculation method for non residential buildings is in development and will be completed in 2009.</p>
Requirements in force since	November 1995

Resulting U-values

Model building N° Building type		3					
		school					
Variant N° variant name		3-0	3-1	3-2	3-3	3-4	
		basis	hg-bnc	hg-pellet	hg-hp	vent-nomec	
U-values		U-value defined for temperature difference between room and ...					
roof	external air	0,32	0,32	0,32	0,32	0,32	[W/(m²K)]
wall	external air	0,51	0,51	0,51	0,51	0,51	[W/(m²K)]
wall to soil	soil	0,51	0,51	0,51	0,51	0,51	[W/(m²K)]
windows	external air	1,14	1,14	1,14	1,14	1,14	[W/(m²K)]
doors	external air	1,71	1,71	1,71	1,71	1,71	[W/(m²K)]
floor	soil	0,51	0,51	0,51	0,51	0,51	[W/(m²K)]
Restricting limit							
		mean U-Value	mean U-Value	mean U-Value	mean U-Value	mean U-Value	
Remarks							
		values comply with "Règlement grand-ducal du 22 novembre 1995" and with "Commodo-Incommodo procedure" (environmental procedure)	values comply with "Règlement grand-ducal du 22 novembre 1995" and with "Commodo-Incommodo procedure" (environmental procedure)	values comply with "Règlement grand-ducal du 22 novembre 1995" and with "Commodo-Incommodo procedure" (environmental procedure)	values comply with "Règlement grand-ducal du 22 novembre 1995" and with "Commodo-Incommodo procedure" (environmental procedure)	values comply with "Règlement grand-ducal du 22 novembre 1995" and with "Commodo-Incommodo procedure" (environmental procedure)	

Mean heat transmission losses (basis for cross country comparison)

element area		correction factor (only for cross- country comparison)	heat transfer coefficient					
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	
roof	1560,9	1	499,5	499,5	499,5	499,5	499,5	
wall	1242	1	633,4	633,4	633,4	633,4	633,4	
wall to soil	226,8	0,6	69,4	69,4	69,4	69,4	69,4	
windows	364,8	1	415,9	415,9	415,9	415,9	415,9	
doors	17,8	1	30,4	30,4	30,4	30,4	30,4	
floor	1560,9	0,35	278,6	278,6	278,6	278,6	278,6	
sum	4973,2		1927	1927	1927	1927	1927	
Mean heat transmission losses per m² envelope (not considering thermal bridges)			0,39	0,39	0,39	0,39	0,39	[W/(m²K)]

Applied method

Country	France
Region	Alsace (H1b)
Type of requirements / method used to proof the compliance	<p>1) use the "reference" U values of each building fabric component to calculate the building overall Uvalue = Ubatref and the project values to calculate Ubat</p> <p>2) make sure the result is lower than 1,2 x the "reference" Ubat</p> <p>3) calculate the project consumption (C in kWh/m2 primary energy) and the reference consumption Cref for the building with reference values for building fabric and energy systems</p> <p>4) Check compliance in having $C < C_{ref}$ and $C < C_{pmax}$ which is an absolute figure depending only on the energy and the location : this step is for housing only, it does not apply to the 3rd building case where compliance is checked with $C < C_{ref}$</p> <p>5) depending on the result, iterate by modifying some Uvalues to comply with the "lowest" effort. depending on the system that is selected.</p>
Requirements in force since	September 2006

Resulting U-values

Model building N° Building type		3					
		school					
Variant N° variant name		3-0	3-1	3-2	3-3	3-4	
		basis	hg-bnc	hg-pellet	hg-hp	vent-nomec	
U-values		U-value defined for temperature difference between room and ...					
roof	external air	0,3	0,27	0,3	0,27	0,25	[W/(m²K)]
wall	external air	0,4	0,36	0,4	0,36	0,3	[W/(m²K)]
wall to soil	external air	0,4	0,4	0,4	0,4	0,3	[W/(m²K)]
windows	external air	2,2	2,1	2,2	2,1	1,6	[W/(m²K)]
doors	external air	1,6	1,5	1,6	1,5	1,5	[W/(m²K)]
floor	external air	0,3	0,27	0,3	0,27	0,25	[W/(m²K)]
Restricting limit		Cref of the reference building with the same geometry with reference value for both envelope componenets and systems (non	Ubat ref for the reference building of the same geometry with reference values for building envelope	Cref of the reference building with the same geometry with reference value for both envelope componenets and systems (non	Cref of the reference building with the same geometry with reference value for both envelope componenets and systems (non	Cref of the reference building with the same geometry with reference value for both envelope componenets and systems (non	
Remarks		The above mentioned values take into account the thermal bridges due to junction between floors and walls.	The above mentioned values take into account the thermal bridges due to junction between floors and walls.	The above mentioned values take into account the thermal bridges due to junction between floors and walls.	The above mentioned values take into account the thermal bridges due to junction between floors and walls.	This options is only possible if the building design incorporates ducts or features enabling different ventilation rates by natural ventilation for the different spaces of this school. It is very likely that this option would never be used because of the ventilation constraint	

Mean heat transmission losses (basis for cross country comparison)

element area		correction factor (only for cross-country comparison)	heat transfer coefficient					
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	
roof	1560,9	1	468,3	421,4	468,3	421,4	390,2	
wall	1242	1	496,8	447,1	496,8	447,1	372,6	
wall to soil	226,8	1	90,7	90,7	90,7	90,7	68,0	
windows	364,8	1	802,6	766,1	802,6	766,1	583,7	
doors	17,8	1	28,5	26,7	28,5	26,7	26,7	
floor	1560,9	1	468,3	421,4	468,3	421,4	390,2	
sum	4973,2		2355	2174	2355	2174	1831	
Mean heat transmission losses per m² envelope (not considering thermal bridges)			0,47	0,44	0,47	0,44	0,37	[W/(m²K)]